**DOCUMENT DATA FORM** **Your Name: Nick Carino** 472-L

**Document Title or Description (max. 254 characters): Circle: Same as cover (or fill in below)**

Structural Details - Design Data and criteria for floor trusses

Include work order no. and floor no. if applicable

| Roll # (e.g., CORR-4): CAL 15 | Doc. ID (report #, dwg. #): | |
|---|---|---|
| **Document Date:** 1967 | **Document Author Name:** | **Author Organization:** Jacobs Steel Co. |

**KEYWORDS – HIGHLIGHT ALL THAT APPLY**

**Level 1**

| | | |
|---|---|---|
| Bankers Trust | Project 6 | WTC 4 - South Plaza Bldg. |
| Concourse | Project 7 | WTC 5 - North Plaza Bldg. |
| Electrical Substation | Project 8 | WTC 6 - Customs House |
| Liberty Plaza | WFC 1 - Oppenhiemer Dow | WTC 7 |
| PATH Station | WFC 2 - Tower B | WTC Complex |
| Project 1 | WFC 3 - American Express | WTC Plaza |
| Project 2 | WFC 4 - Tower D | |
| Project 3 | WTC 1 - North Tower | Add |
| Project 4 | WTC 2 - South Tower | |
| Project 5 | WTC 3 - Marriot Hotel | |

**Level 2**

| | | |
|---|---|---|
| Accident analysis & risk | Mech./elec. | Add |
| Architectural | News coverage | |
| Data request | Police | |
| Emergency management | Security | |
| Evacuation | Structural | |
| Fire protection | Tenant alterations | |
| Fire service | | |

**Level 3**

| | | | |
|---|---|---|---|
| 1993 explosion | Deck | Human comfort | Splices |
| A/E fitout | Deflection | HVAC | Sprinkler |
| A-242 | Demolition | Index | Stability |
| A-36 | Design | Inspection | Stairways |
| A-497 | Doors | Insulation | Standards |
| Air cooled condensers | Drawings | Joist | Steel |
| Analysis | Eastern States Steel | L-50 | Steel composition |
| Angles | Egress | Loads | Stiffness |
| Antenna | Elevator | Maintenance | Structural review |
| Artifacts | Emergency communications | Marking | Survivor |
| Asbestos | Equipment | Mesh reinforcement | Tenant list |
| Beams | Escalator | Model | Testing |
| Bow tie | Exterior columns | Mullion | Tie |
| Bracing | Fabrication | Operations | Triad |
| Bridging truss | Family member | Paint | Truss |
| Calculations | Fire alarms | Partition layout | Vestibule |
| Carpet | Fireproofing | Photos | Vibration |
| Ceilings | Fire spread | Pipes | Walls |
| Chillers | Flammability | Plumbing | Water supply |
| Cladding | Floor | Probability, uncertainty | Weather |
| Collapse | Floor load | Reinforcing (strengthening) | Weight |
| Columns | Floor slab | Renovation | Weld size |
| Communication systems | Floor system | Repair | Wind |
| Composite truss | Floor trusses | Safety | Windows |
| Computer output | Foundations | Security system | Yield strength |
| Computer program | Frame | Shear knuckle | |
| Concrete | Frame analysis | Shear test | Add |
| Connections | Frequency | Shop drawings | criteria |
| Construction | Fuel | Shortening | |
| Contract | Furniture layout | Slurry wall | |
| Core beams | Generators | Smoke control | |
| Core columns | Guidelines | Smoke test | |
| Dampers | Gypsum board | Spandrel beam | |
| Debris | Hat truss | Specifications | |

LACLEDE STEEL COMPANY
STRUCTURAL DETAILS
WORLD TRADE CENTER TOWERS
PORT OF NEW YORK AUTHORITY


| Detail No. | Title | Date Transmitted | Approved |
|---|---|---|---|
| ST-101 | Typical 32" composite truss web Intermediate Panel - Full Scale | | |
| ST-102 | Typical web chord sections 32" composite trusses - Full Scale | | |
| ST-103 | Intermediate panel details 24" standard trusses 32" composite trusses - Full Scale | | |
| ST-104 | Intermediate panel details 28" composite trusses 32" composite trusses - Full Scale | | |
| ST-105 | Corner intersection details Continuity of 32" - 60' span composite trusses (CT3, CT3A and CT4) into 28" composite trusses (CT9) in 35' span - Full Scale | | |
| ST-106 | Typical column bearing end detail of 32" composite trusses 2" x 2" damping unit extension Scale ½" = 1" | | |
| ST-106A | Column bearing end detail showing diagonal angle bracing attachment 32" composite trusses Scale ½" = 1" | | |
| ST-106B | Column bearing end detail Typical extended shallow bearing end - 32" composite trusses Scale ½" = 1" | | |
| ST-106C | Column bearing end detail showing damping unit extension for 28" composite trusses 24" standard trusses Scale ½" = 1" | | |

| Detail No. | Title | Date Transmitted | Approved |
|---|---|---|---|
| ST-106D | Column bearing end detail showing diagonal angle bracing attachment 28" composite trusses 24" standard trusses Scale ½" = 1" | | |
| ST-106E | Column bearing end detail Typical extended shallow bearing end 28" composite trusses 24" standard trusses Scale ½" = 1" | | |
| ST-107 | 32" composite truss details Approximate 60' span Type CT1, CT2, CT3, CT3A and CT4 - Scale 1½" = 1'0" | | |
| ST-108 | 32" composite truss details Approximate 35' span Type CT5 and CT6 Scale 1½" = 1'0" | | |
| ST-109 | 28" composite truss details Corner construction Type CT7, CT8 & CT9 Scale 1½" = 1'0" | | |
| ST-110 | 24" standard truss details 20'0" transverse ST8, ST10, ST11 and ST12 (duct) 13'4" transverse ST13 Scale 1½" = 1'0" | | |
| ST-111 | Cover plate details .0135" plates A, B, and C | | |
| ST-112 | Cover plate details .0135" plates D, E, and F | | |

| Detail No. | Title | Date Transmitted | Approved |
|---|---|---|---|
| ST-113 | 32" composite truss details<br>Typical column end bearing details - trusses CT1, 2, 3, 3A, 4, 5, and 6<br>Core end details 58'6", 58'3", and 57'7" spans - trusses CT1 and 2 - Full Scale | | |
| ST-114 | 32" composite truss details<br>Core end bearing details 59'9" and 59'8" spans - trusses CT1 and 2 - Full Scale | | |
| ST-115 | 32" composite truss details<br>Core end bearing details 59'3", 59'2", and 58'11" spans<br>Trusses CT1 and 2 - Full Scale | | |
| ST-116 | 32" composite truss details<br>Core end bearing details<br>Trusses CT5 and CT6 35'8" span<br>Full Scale | | |
| ST-117 | 28" composite truss details<br>Truss CT7 - 19'6" span<br>24" standard-truss details<br>Truss ST10 - 19'6" span<br>Column end bearing detail<br>Full Scale | | |

LACLEDE STEEL COMPANY
FLOOR GRID-PANEL & PANEL LOCATIONS
WORLD TRADE CENTER TOWERS
PORT OF NEW YORK AUTHORITY

| Detail No. | Title | Date Transmitted | Approved |
|---|---|---|---|
| L-100 | Typical floor plan - showing panel designation, truss location, applicable design moments and end reaction for truss design - Scale 1/8" = 1'0" | | |
| L-101 | Quarter plan - Typical floor showing panel designation, truss location, truss designation and truss web configuration Scale 1/8" = 1'0" | | |

LACLEDE STEEL COMPANY
DESIGN CALCULATIONS
WORLD TRADE CENTER TOWERS
PORT OF NEW YORK AUTHORITY


| Sheet No. | Design Data | Date Transmitted | Approved |
|---|---|---|---|
| D100-1 thru 7 | Basic Design Data | | |
| D101 | Chord Angle Properties 2" x 1/2" angles | | |
| D102 | Chord Angle Properties 3" x 2" angles | | |
| D103 | Round Web Properties | | |
| D104 | Miscellaneous Section Properties | | |
| D105-T1 | Design Data Truss Mk. 2C32T1 | | |
| D105-T2 | Design Data Truss Mk. 2C32T2 | | |
| D105-T3 | Design Data Truss Mk. 2C32T3 | | |
| D105-T3A | Design Data Truss Mk. 2C32T3A | | |
| D105-T4 | Design Data Truss Mk. 2C32T4 | | |
| D105-T5 | Design Data Truss Mk. 2C32T5 | | |
| D105-T6 | Design Data Truss Mk. 2C32T6 | | |
| D105-T7 | Design Data Truss Mk. C28T7 | | |
| D105-T8 | Design Data Truss Mk. C28T8 | | |
| D105-T9 | Design Data Truss Mk. C28T9 | | |
| D105-T10 | Design Data Truss Mk. S24T10 | | |
| D105-T11 | Design Data Truss Mk. S24T11 | | |
| D105-T12 | Design Data Truss Mk. S24T12 | | |
| D105-T13 | Design Data Truss Mk. S24T13 | | |
| D105-ET1 | Design Data Extended End Truss Mk. 2C32ET1 | | |
| D105-ET2 | Design Data Extended End Truss Mk. 2C32ET2 | | |
| D105-ET3 | Design Data Extended End Truss Mk. 2C32ET3 | | |

| Sheet No. | Design Data | Date Transmitted | Approved |
|---|---|---|---|
| D105-ET3A | Design Data Extended End Truss Mk. 2C32ET3A | | |
| D105-ET4 | Design Data Extended End Truss Mk. 2C32ET4 | | |
| D105-ET5 | Design Data Extended End Truss Mk. 2C32ET5 | | |
| D105-ET6 | Design Data Extended End Truss Mk. 2C32ET6 | | |
| D105-ET7 | Design Data Extended End Truss Mk. C28ET7 | | |
| D105-ET10 | Design Data Extended End Truss Mk. S24ET10 | | |

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# BASIC DESIGN DATA

Based on double truss units. Mark 2CT__ or 2ST__.
Single truss components. Mark CT__ or ST__.

## DIMENSIONS:

Unless specifically noted otherwise, see "ST" Details.

Truss clearspan in feet = L. Overall length of truss minus end bearings in feet (2 x 5" = 10"). Example: 59'9" overall length. Clearspan L = 59'9" minus 10" or 58'11" or 58.92'.

Length of member, clear of attachments = "$\ell$"

### Depth of Truss

Composite type "C" (Measured top of shear member to bottom of lower chord.)

Standard type "S" (Measured out to out of chord members.)

Total depth of composite section = "$D_t$"

## TOLERANCES:

Overall length 1/4"+ or 1/4"-.

Depth 1/8"+ or 1/8"-.

## LOADS:

Total load = Live load + Dead load

Applicable for composite design.

Applicable for combined slab and top chord design and bottom chord design.

Construction load = Applicable Dead load

Applicable for top and bottom chord steel design.

Dead load = Actual weight of structural system in pounds per square foot.

Live load = Assigned live load for panel area in pounds per square foot.

Design load in pounds per square foot = "$w$"

Applicable design load in pounds per foot equals design load in pounds per square foot times spacing of trusses in feet = . . . . . "W"

TOTAL MOMENT:

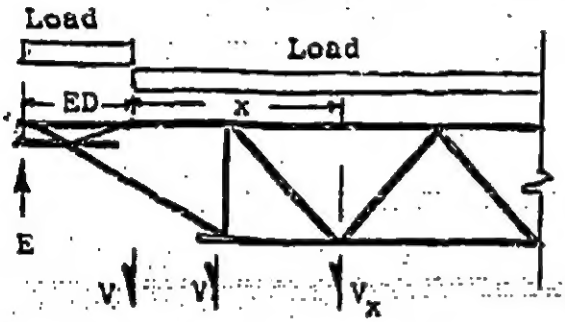
"M" (In inch pounds) = $WL^2$ x 1.5.

END REACTION:

"R" (In pounds) = "W" x .5 (overall length of truss in feet).

SHEAR:

At first top chord panel in pounds = V = R- (W x ED)

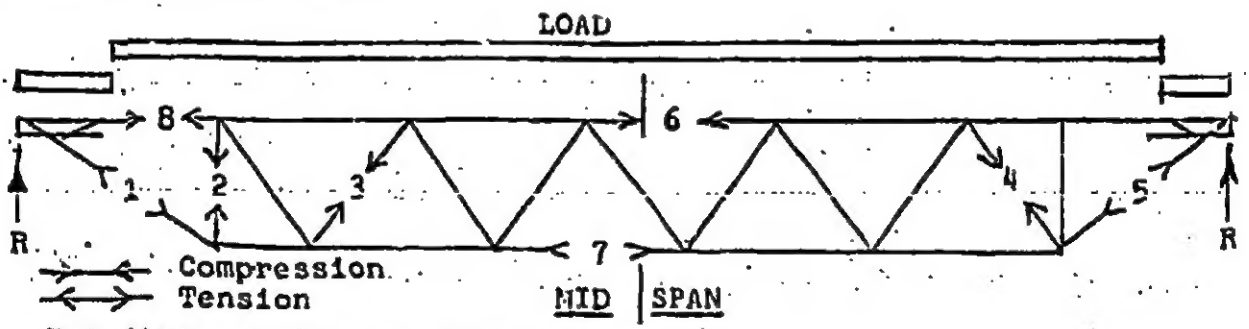



ED = Distance first top chord panel point to truss end.

Shear at other points in pounds = $V_x$ = (R- ED x W)-W (distence to first top chord panel point in feet).

(In no case less than 50% of end reaction "R".)

DESIGNATION OF MEMBERS:




1. End diagonal (long end) tension member
2. First panel vertical (long end) compression
3. Second panel compression diagonal
4. First panel vertical (short end) compression
5. End diagonal (short end) tension
6. Top chord critical compression member at mid span
7. Bottom chord critical tension member at mid span
8. End top chord compression member (long end)

MATERIALS:

A-36 steel . . . . . 36 ksi minimum yield strength

A-441 modified . . . . . 50 ksi minimum yield strength low alloy "H" Series.

See sheets D101 through D103 for Properties of Sections.

APPLICABLE FORMULAE: Stress Determination (Web or Chord Members)

A-36 steel

(36 ksi minimum yield)

$f_y$ = Minimum Yield Strength 36,000 psi

$f_s$ = Tension 22,000 psi

$f_{sc}$ = Compression for $\ell/r < 127$ $\quad 18{,}540 - .574\,(\ell/r)^2$ psi

for $\ell/r > 127$ $\quad \dfrac{149{,}000{,}000}{(\ell/4)^2}$ psi

$\ell$ = clear distance between attachments

r = least radius of gyration

A-441 steel

(50 ksi minimum yield)

$f_y$ = Minimum Yield Strength 50,000 ksi

$f_s$ = Tension 30,000 psi

$f_{sc}$ = Compression for $\ell/r < 108$ $\quad 25{,}750 - 1.108\,(\ell/r)^2$ psi

for $\ell/r > 108 < 200$ $\quad \dfrac{149{,}000{,}000}{(\ell/r)^2}$ psi

Continuous members shall be designed for only axial compressive stress when the panel length clear of attachments does not exceed 24". When the panel length clear of attachments exceeds 24", the top chord shall be designed as a continuous member subject to combined axial and bending stress and shall be of proportion that the quantity -

$$\frac{f_a}{30{,}000} + \frac{f_b}{F_b}$$

does not exceed unity at the panel point, or that the quantity -

$$\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \dfrac{f_a}{F'_e}\right)}$$

does not exceed unity at the mid panel.

Permissible axial unit compressive stress = "$F_a$"

Permissible bending unit stress = "$F_b$"

Permissible compressive stress factor (column equation $\dfrac{149{,}000{,}000}{(\ell/r)^2}$ psi) = "$F'_e$"

Actual axial unit compressive stress = . . . . . $f_a$

Actual bending unit stress = . . . . . $f_b$

MAXIMUM SLENDERNESS RATIOS:

Top chord panels (interior) = 85
Top chord end panels = 120
Compression members other than top chord = 200
Tension members = 240

FILLERS OR TIES:

Members in compression composed of two components shall have fillers or ties spaced so that the ratio of $\ell/r$ of each component shall not exceed the ratio of $\ell/r$ of the whole member. The minimum "r" shall be used in calculating the critical ratio $\ell/r$ of any component.

SHEAR CONNECTORS:

ok 15K ?

Shall be considered to provide a minimum 15 ksi horizontal shear per web end connector imbedded in the concrete. This is for 3,000 psi concrete. ($f_s$)

DEFLECTION:

Applicable deflection formula for uniform load.

Maximum deflection $\Delta = \frac{25.88\ (WL^4)}{29{,}000{,}000I}$

COMPOSITE SLAB AND JOIST DESIGN:

Design values

Total depth of combined slab and truss in inches = . . . . . $D_t$

Effective width of concrete flange in inches equal to 2 x 8t = . . . . . $B_{eff}$

Distance from top of concrete flange to neutral axis of concrete flange = . . . . . $y_1$

Distance from top of concrete flange to neutral axis of top chord angles = . . . . . $y_2$

Distance from top of concrete flange to neutral axis of bottom chord angles = . . . . . $y_3$

Distance from top of concrete flange to neutral axis of composite section = . . . . . $y$

Distance from neutral axis of composite section to neutral axis of concrete flange = . . . . . $d_1$

Distance from neutral axis of composite section to neutral axis of top chord angles = . . . . . $d_2$

Distance from neutral axis of composite section to neutral axis of bottom chord angles = . . . . . $d_3$

Distance from neutral axis of composite section to outermost fibers of compression chord = . . . . . $c_1$

Distance from neutral axis of composite section to outermost fibers of tension chord = . . . . . $c_2$

Allowable concrete strength $f_c$ = 3,000 pounds psi.

Allowable steel strength = . . . . . $f_s$

Allowable concrete compressive stress $f'_c$ = 1,350 pounds psi.

Actual concrete compressive stress = . . . . . $f'_{cc}$

Allowable steel compressive stress = . . . . . $f_{sc}$

Modular ratio = 15 = . . . . . $\frac{E_s}{E_c}$

SECTION PROPERTIES: (Refer to Sheets D101 through D103)

Moment of inertia of concrete = . . . . . $I_c$

Moment of inertia of top chord angles = . . . . . $I_{TCA}$

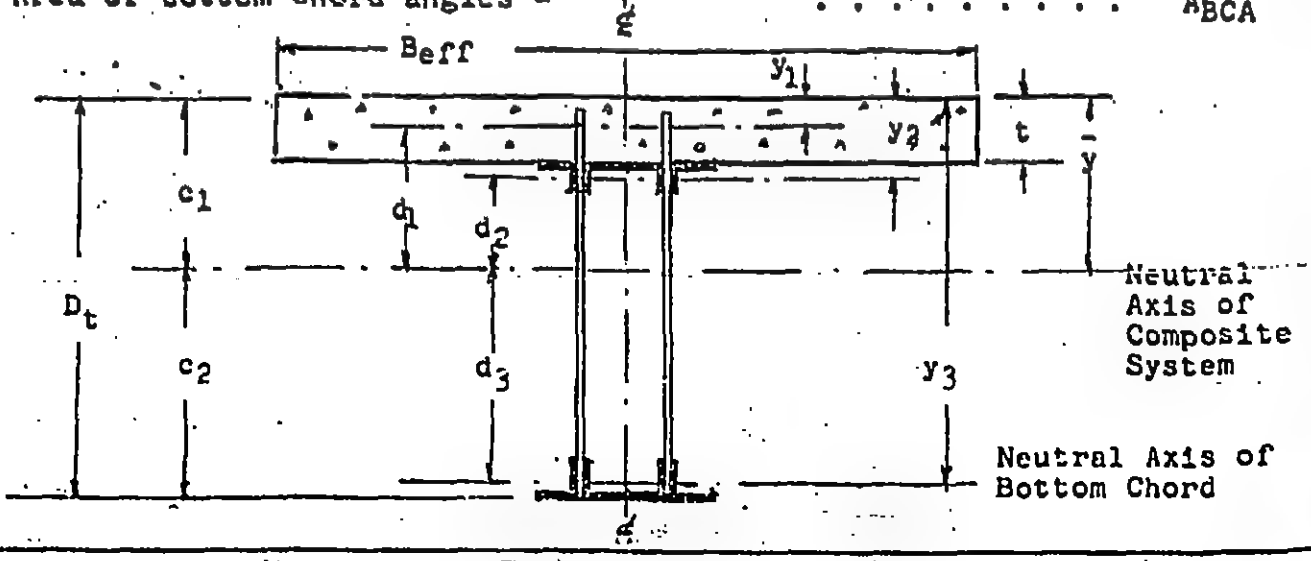
Moment of inertia of bottom chord angles = . . . . . $I_{BCA}$

Moment of inertia of composite system = . . . . . $I_S$

Area of concrete flange = . . . . . $A_c$

Area of top chord angles = . . . . . $A_{TCA}$

Area of bottom chord angles = . . . . . $A_{BCA}$



FORMULAE:

Resisting moment = "RM"

Allowable unit stress times the applicable Section Modulus = (applicable f x S).

Section Modulus (about the axis of bending) = $S = \frac{I}{C_1 \text{ or } C_2}$

QUALITY CONTROL AND INSPECTION:

Material Test Reports

Since all steel employed in the fabrication of trusses is produced in the furnaces and mills of Laclede Steel Company, certified mill test reports showing heat numbers, chemistry, and physical properties for all steel components will be provided.

Resistance Welding

Truss panel points will be connected by electronically controlled resistance welding providing two times the strength of the connected members at full design load.

Angle chords of carbon and alloy steel to be of weldable grade with contact surfaces cleaned of scale by shot blasting prior to welding.

Welds to be subject to "on-line" testing by measured hydraulic wedge action tester with spot checking of finished panel point welds by testing in vertical double shear to two times design load value.

Any panel point welds indicated to have less than the established factor for weld shear strength will be arc welded, subsequent to testing.

Full design load tests will be effected on full size and full length truss components by hydraulic loading in a test frame with load measurement by electric load cell and center span deflection check.

Load tests with recorded deflection and recovery data will be made on a minimum of one of each identified truss style involved in the panel construction.

Physical Tension Tests

Tension tests on truss components, chord angles, and webs will be performed on selected sample members included in the normal truss fabrication.

Inspection and Access to Plant

Free access to the plant of the truss manufacturer and the

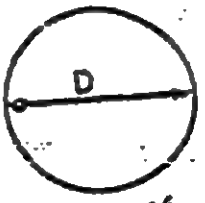
available inspection and test facilities will be offered the qualified inspectors representing the purchaser for observation of the test and inspection procedures outlined herein.

Any testing requested beyond that identified herein shall be for the account of the purchaser.

LACLEDE STEEL COMPANY SAINT LOUIS, MISSOURI

DRAWING NO. D-103 SUBJECT WORLD TRADE CENTER TOWERS
BY L.J.S DATE 2-6-67 THE PORT OF NEW YORK AUTHORITY
CHKD. BY A.C.W DATE 2-7-67

TRUSS SECTION COMPONENTS
TRUSS WEB SECTIONS
DESIGN SECTION PROPERTIES




.98

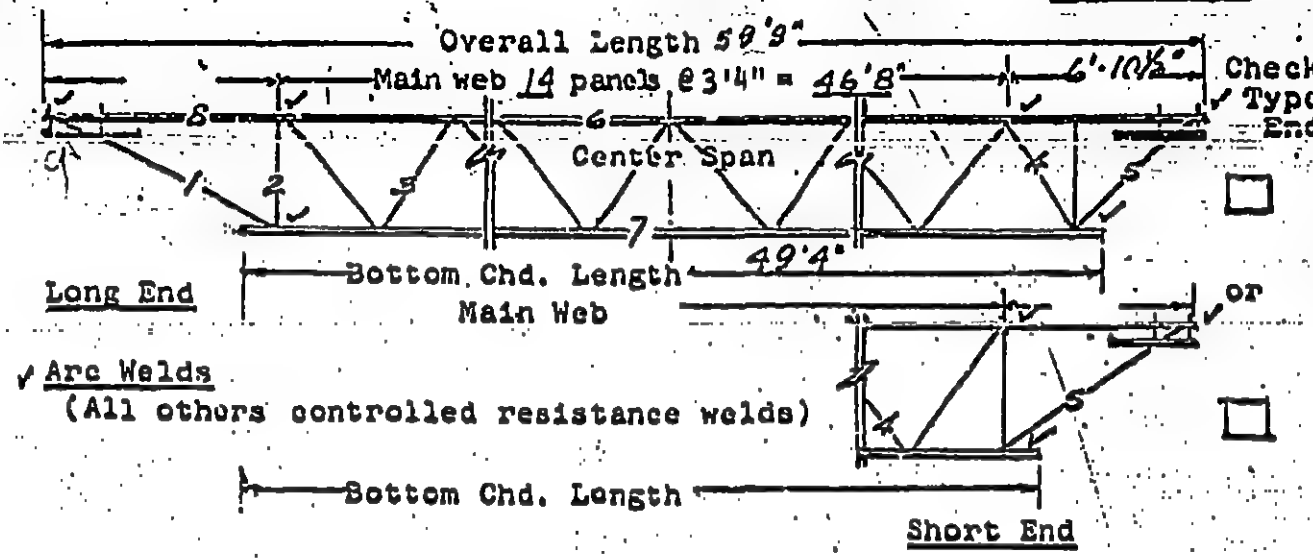
.99

| DIAMETER | 0.62 in | 0.75 in | 1.00 in | 1.14 in | 0.75 IN |
|---|---|---|---|---|---|
| AREA | 0.666 in² | 0.770 in² | 0.933 in² | 1.021 in² | 0.44 IN² |
| RAD. OF GYR. | 0.230 in | 0.245 in | 0.273 in | 0.285 in | 0.1875 IN |
| LBS/FT | 2.26 | 2.62 | 3.17 | 3.45 | |

# WORLD TRADE CENTER FLOOR GRID TRUSSES DESIGN DATA

Truss Mk. 2C52T1-599

Truss Component Mk. C32T1-599




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 3".

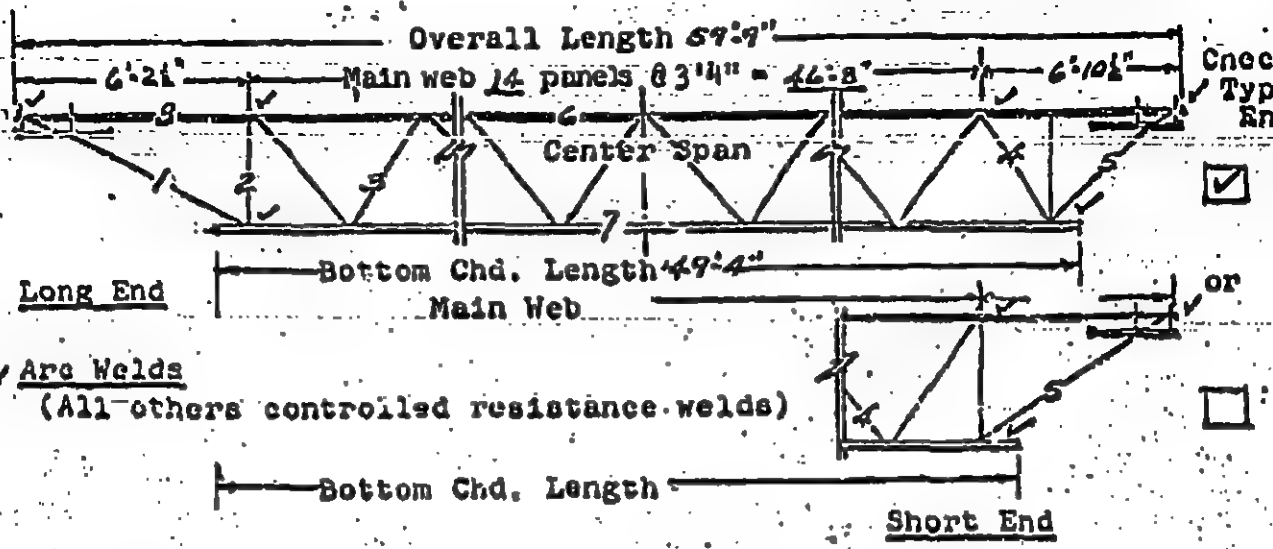
MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C—

| Member | Mk.No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2-2" x 1½" x 0.25"† | | |
| Bottom Chord | 7 | A-36 | 2-3" x 2" x 0.31"† | | |
| Main Web | 3 | A-36 | 1.09" DIA. | | |
| Compression Web | 4 | A-441 | 1.14" DIA. | | |
| Vertical End Struts | 2 | A-36 | 1.09" DIA. | | |
| Long End Diagonal | 1 | A-441 | 1.14 (1.09)" DIA. | | |
| Short End Diagonal | 5 | A-441 | 1.14" DIA. | | |

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. 2C32T1-599

Truss Component Mk. C32T1-599




✓ Arc Welds
(All others controlled resistance welds)

**NOTES:**

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 4".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C ✓

| Member | Mk.No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2-2" x 1½" x 0.25" ∡ | | |
| Bottom Chord | 7 | A-36 | 2-5" x 2" x 0.37" ∡ | | |
| Main Web | 3 | A-36 | 1.09" DIA | | |
| Compression Web | 4 | A-441 | 1.14" DIA | | |
| Vertical End Struts | 2 | A-36 | 1.09" DIA | | |
| Long End Diagonal | 1 | A-441 | 1.14" DIA | | |
| Short End Diagonal | 5 | A-441 | 1.14" DIA | | |

SPECIAL SECTIONS

(Extended, square ends, etc.)

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32T1 Refer to drawings ST 101.6.7.

Clearspan "L" = 58.92 ft. Spacing = 6.67 ft.

Applicable Total Moment = 4,570,000 inch pounds.

Based on 129 lbs./sq. ft. Total Load "w".

Applicable End Reaction = 25,500 pounds.

Based on 129 lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 1,740,000 inch pounds.

Based on 50 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 10,000 pounds.

Based on 50 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 22,940 pounds. ED = 3.00 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 22,940 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 2.05 sq. in. Use 2-1.14" DIA Area = 2.04 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 22,940 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$\ell$ = 25.5 in. $f_{sc}$ = 13,510 psi

Reqd. Area = 1.69 sq. in. Use 2-1.09" DIA Area = 1.87 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 18,780 lbs. $f_y$ = 36,000 psi

Slope = 1.162 $f_s$ = — psi

$\ell$ = 29.5 in. $f_{sc}$ = 11,820 psi

Reqd. Area = 1.85 sq. in. Use 2-1.09" DIA. Area = 1.87 sq. in.

WEB MEMBER #4 Distance from End Panel = 3.04 ft.

Applicable Shear $V_x$ = 20,340 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$\ell$ = 29.5 in. $f_{sc}$ = 13,850 psi

Reqd. Area = 1.71 sq. in. Use 2-1.14" O.D. Area = 2.04 sq. in.

WEB MEMBER #5 Distance from End Panel = 3.80 ft.

Applicable Shear $V_x$ = 22,940 lbs. $f_y$ = 50,000 psi

Slope = 2.20 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.68 sq. in. Use 2-1.14" O.D. Area = 2.04 sq. in.

CHORD MEMBER #6 Consists of 4 - 2" x 1½" x 0.25" Angles

Construction Load Design Area = 3.60 sq. in.

Applicable Moment = 1,740,000 in. lbs. $f_y$ = 50,000 psi

$\ell$ = 33.375 in. $f_s$ = — psi

$r_x$ = 0.44 in. $f_{sc}$ = 19,380 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{\ell}{r_x}$ = 75.8

$\frac{\ell}{2r_z}$ = 53.8 $\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \frac{f_a}{F'_e}\right)}$ = 0.949 less than 1

$f_a$ = 17,260 psi

$F_a$ = 19,380 psi

$f_b$ = 810 psi

$F_b$ = 30,000 psi

$F'_e$ = 25,950 psi

Use 4 - 2" x 1½" x 0.25" L's Area = 3.60 sq. in.

CHORD MEMBER #7 Consists of 4 - 3" x 2" x 0.37" Angles

Total Load Design Area = 7.32 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 4,570,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 35.00 in. $f_{sc}$ = ——— psi

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 5.86 in.

$y_2$ = 4.44 in. $d_3$ = 26.44 in.

$y_3$ = 32.44 in. $c_1$ = 10.30 in.

$d_1$ = 8.30 in. $c_2$ = 22.70 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 10.30 in.

$I_s$ = 1913 $in.^4$ ( 2C32T1 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 4,770,000 in. lbs.

Use 4 - 3" x 2" x 0.37" A's Area = 7.32 sq. in.

Composite Design: Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 4,570,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{co} = \frac{M c_1}{15 I_s} = 640 \text{ psi}$$

CHORD MEMBER #8 Consists of 4 - 2" x 1½" x 0.25" Angles

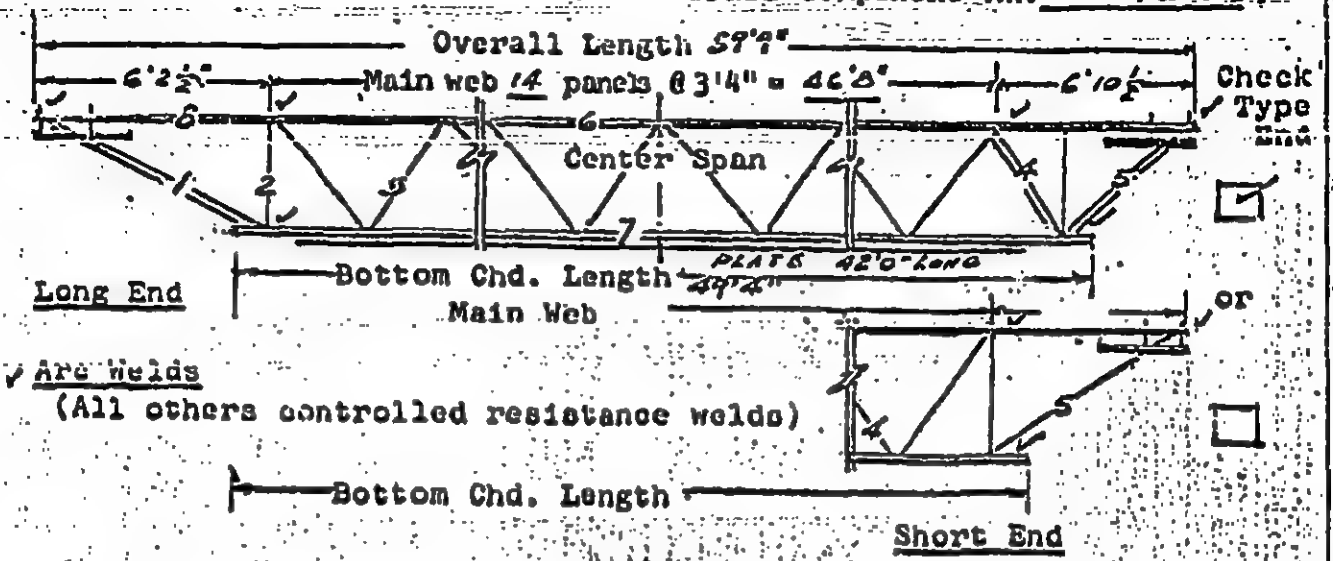
Area = 3.60 sq. in.

(SAME AS MEMBER 6)

# WORLD TRADE CENTER FLOOR GRID TRUSSES DESIGN DATA

Truss Mk. 2 C32T2-599

Truss Component Mk. C32T2-599




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 3 ".

MEMBERS REQUIRED PER TRUSS COMPONENT S ____ or C ✓

| Member | Mk.No. | Grade of Steel | | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|---|
| Top Chord | 6-8 | A 441 | 2 | 2×1½×.31" | 59'9" | |
| Bottom Chord | 7 | 36 | 2 | 2×1½×.31" | 49'4" | |
| Main Web | 3 | 441 | | 1.14" D | 86'4" | |
| Compression Web | 4 | 441 | | 1.14"D+.75"D | 3'1" 5'0" | |
| Vertical End Struts | 2 | 441 | | 1.14" D | 2'7½" 2'3½" | |
| Long End Diagonal | 1 | 441 | | 1.14"D+.75"D | 6'6" 6'4" | |
| Short End Diagonal | 5 | 441 | | 1.14"D+.75"D | 5'8" 5'6" | |
| Bott. Chord Plate | | A 36 | | .3125×1'3" | 42'0" | |

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32T2 Refer to drawings ST 101.2.167

Clearspan "L" = 59.00 ft. Spacing = 6.67 ft.

Applicable Total Moment = 5630,000 inch pounds.

Based on 157 lbs./sq. ft. Total Load "w".

Applicable End Reaction = 31,300 pounds.

Based on 157 lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 1860,000 inch pounds.

Based on 52 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 10,360 pounds.

Based on 52 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 28,150 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 28,150 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = ——— in. $f_{sc}$ = ——— psi

Reqd. Area = 2.49 sq. in. Use 2-1.14"DIA. + 2-0.75"DIA. Area = 2.92 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 28,150 lbs. $f_y$ = 50,000 psi

Slope = 1.00 $f_s$ = ——— psi

$\ell$ = 26.0 in. $f_{sc}$ = 16,530 psi

Reqd. Area = 1.84 sq. in. Use 2-1.14"DIA. Area = 2.04 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 23,050 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = ——— psi

$\ell$ = 30.0 in. $f_{sc}$ = 13,490 psi

Reqd. Area = 1.99 sq. in. Use 2-1.14"DIA. Area = 2.04 sq. in.

WEB MEMBER #4 Distance from End Panel = 3.04 ft.

Applicable Shear $V_x$ = 24,950 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 30.0 in. $f_{sc}$ = 13,490 psi

Reqd. Area = 2.15 sq. in. Use 2-1.14" DIA. + 2-0.75" DIA. Area = 2.92 sq. in.

WEB MEMBER #5 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 28,150 lbs. $f_y$ = 50,000 psi

Slope = 2.20 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 2.06 sq. in. Use 2-1.14" DIA. + 2-0.75" DIA. Area = 2.92 sq. in.

CHORD MEMBER #6 Consists of 4-2"x1½"x0.31" Angles

Construction Load Design Area = 4.30 sq. in.

Applicable Moment = 1,860,000 in. lbs. $f_y$ = 50,000 psi

$l$ = 33.375 in. $f_s$ = — psi

$r_x$ = 0.43 in. $f_{sc}$ = 19,080 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{l}{r_x}$ = 77.6

$\frac{l}{2r_z}$ = 53.8

$\frac{f_a}{F_a} + \frac{f_b C_m}{F_b(1-\frac{f_a}{F'_e})}$ = 0.859 less than 1

$f_a$ = 15,400 psi

$F_a$ = 17,080 psi

$f_b$ = 770 psi

$F_b$ = 30,000 psi

$F'_e$ = 24,770 psi

Use 4-2"x1½"x0.31" L's Area = 4.30 sq. in.

CHORD MEMBER #7 Consists of 4-2"x1½"x0.31"L's + 15"x5/16" PL Angles

Total Load Design Area = 8.99 (4.69 + 4.30) sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 5,630,000 in lbs. $f_y$ = 36,000 psi

$D_t$ = 33.31 in. $f_s$ = 22,000 psi

$B_{eff}$ = 64.00 in. $f_{cc}$ = ——— psi

t = 4.00 in. $y_4$ = 33.16 in.

$y_1$ = 2.00 in. $d_4$ = 21.67 in.

$y_2$ = 4.46 in. $d_2$ = 7.03 in.

$y_3$ = 32.54 in. $c_3$ = 21.05 in.

$d_1$ = 9.49 in. $c_1$ = 11.49 in.

$c_2$ = 21.82 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3^2]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 11.49 in.

$I_s$ = 5,877 in.$^4$ (2 C32T2 + PLATE)

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 5,920,000 in. lbs.

Use 4-2"x1½"x0.31" Angles + 15"x5/16" PL Area = 8.99 sq. in.

Composite Design Top Chord Check

Total Load Design

Applicable Moment = 5,630,000 in. lbs. $f_c$ = 3,000 psi

$f'_c$ = 1,350 psi

$$f'_{cc} = \frac{M_{cl}}{15 I_s} = 733 \text{ psi}$$

CHORD MEMBER #8 Consists of 4-2"x1½"x0.31" Angles

Area = 4.30 sq. in.

(SAME AS MEMBER 6)

CHORD MEMBER #7 (CONTD.)

Applicable Moment = _____ in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 33.00 in. $f_{sc}$ = ____ psi

$B_{eff}$ = 64.00 in.

t = 4.00 in. WITHOUT COVER PLATE

$y_1$ = 2.00 in. $d_2$ = 3.08 in.

$y_2$ = 4.46 in. $d_3$ = 25.00 in.

$y_3$ = 32.54 in. $c_1$ = 7.54 in.

$d_1$ = 5.54 in. $c_2$ = 25.46 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 7.54 in.

$I_s$ = 3,275 $in.^4$ (2C52T2)

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,830,000 in. lbs.

Use 4-2"x1½"x0.31" ∠'s Area = 4.30 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = _____ psi

Applicable Moment = _____ in. lbs. $f'_c$ = _____ psi

$$f'_{cc} = \frac{M_{cl}}{15 I_s} = \_\_\_\_\_ \text{ psi}$$

CHORD MEMBER #8 Consists of _____ Angles

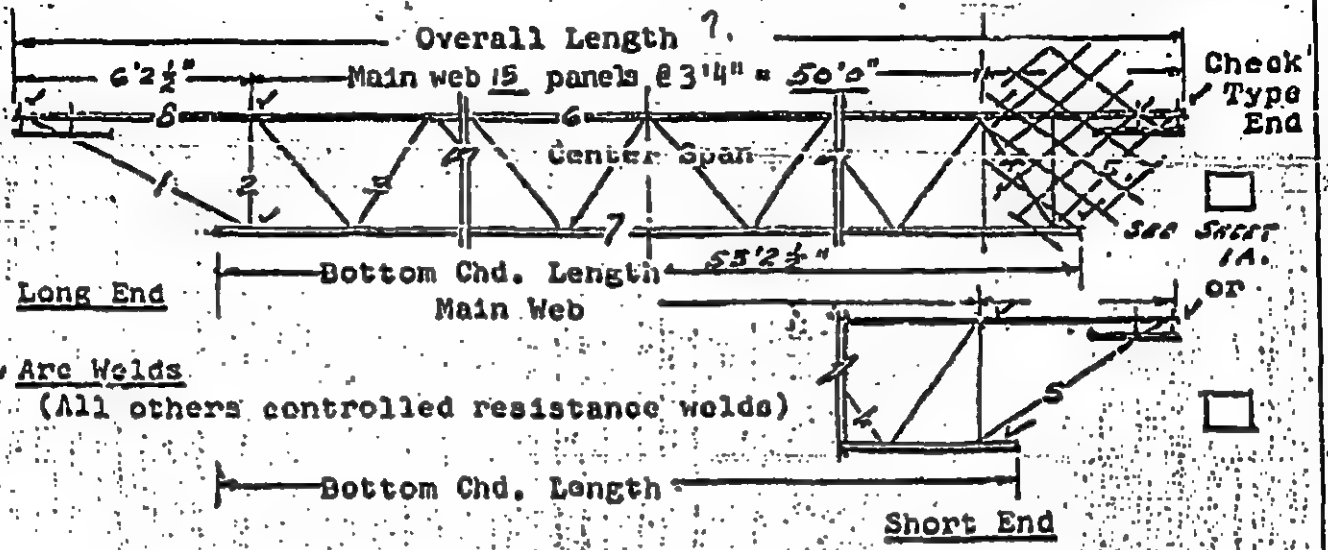
Area = _____ sq. in.

(SAME AS MEMBER 6)

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. 2C32T3 - 5811

Truss Component Mk. C32T3-5811




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 3".

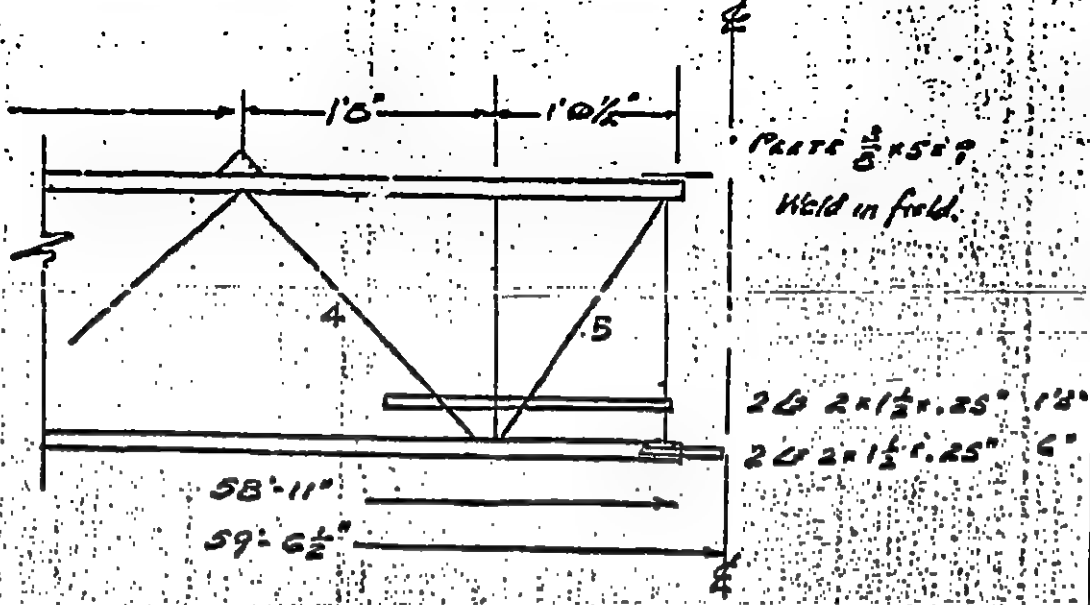
MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C✓

| Member | Mk. No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A 441 | 2 L's 2x1½x.25 | 58'9" | |
| Bottom Chord | 7 | 36 | 2 L's 3x2x.33 | 53'2½" | |
| Main Web | 3 | 36 | 1.09"D | 91'6" | |
| Compression Web | 4 | 441 | 1.14"D | 3'1" | |
| Vertical End Struts | 2 | 36 | 1.09"D | 2-2'7½" 2-2'3½" | |
| Long End Diagonal | 1 | 441 | 1.14"D | 6'6" | |
| Short End Diagonal | 5 | 441 | 1.14"D | 2'6" | |
| Top Chd Att. Plate | | A 36 | 3/8x5" (½ Truss) | 9" | |
| Bot Chord Att. L's | | 36 | 2 L's 2x1½x.25 | 1'3" | |
| " " " L's | | 36 | 2 L's " | 6" | |

SPECIAL SECTIONS

(Extended, square ends, etc.)

2032 T6




$$R = \frac{(6.67)(.121)(59.24)}{2} = 24.00\ K$$

$$V_5 = 24.0 - \frac{14}{12}(.121)(6.67) = 23.06\ K$$

$$V_6 = V_5 - \frac{16}{12}(.121)(6.67) = 21.98\ K$$

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32T3 Refer to drawings ST 101, 2, 4, 6, 7.

Clearspan "L" = 59.08 ft. Spacing = 6.67 ft.

Applicable Total Moment = 4 275,000 inch pounds.

Based on 121 lbs./sq. ft. Total Load "w".

Applicable End Reaction = 24,000 pounds.

Based on 121 lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 1,815,000 inch pounds.

Based on 52 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 10,300 pounds.

Based on 52 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 21,580 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 21,580 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.91 sq. in. Use 2-1.14" DIA. Area = 2.04 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 21,580 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$l$ = 25.5 in. $f_{sc}$ = 13,510 psi

Reqd. Area = 1.59 sq. in. Use 2-1.09" DIA. Area = 1.87 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 17,650 lbs. $f_y$ = 36,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 29.5 in. $f_{sc}$ = 11,820 psi

Reqd. Area = 1.73 sq. in. Use 2-1.09" DIA. Area = 1.87 sq. in.

WEB MEMBER #4 Distance from End Panel = 2.50 ft. (ED = 0)

Applicable Shear $V_x$ = 21980 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 29.5 in. $f_{sc}$ = 13,580 psi

Reqd. Area = 1.88 sq. in. Use 2 - 1.14" DIA. Area = 2.04 sq. in.

WEB MEMBER #5 Distance from End Panel = 1.17 ft. (ED = 0)

Applicable Shear $V_x$ = 23,060 lbs. $f_y$ = 50,000 psi

Slope = 1.06 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 0.815 sq. in. Use 2 - 1.14" DIA. Area = 2.04 sq. in.

CHORD MEMBER #6 Consists of 4 - 2" x 1½" x 0.25" Angles

Construction Load Design Area = 3.60 sq. in.

Applicable Moment = 1,815,000 in. lbs. $f_y$ = 50,000 psi

$l$ = 33.375 in. $f_s$ = — psi

$r_x$ = 0.44 in. $f_{sc}$ = 19,380 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{l}{r_x}$ = 75.8

$\frac{l}{2r_z}$ = 53.8 $\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \frac{f_a}{F'_e}\right)}$ = 0.995 less than 1

$f_a$ = 18,000 psi

$F_a$ = 19,380 psi

$f_b$ = 843 psi

$F_b$ = 30,000 psi

$F'_e$ = 25,950 psi

Use 4 - 2" x 1½" x 0.25" Area = 3.60 sq. in.

CHORD MEMBER #7 Consists of 4 - 3" x 2" x 0.33" Angles

Total Load Design Area = 6.62 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 4,275,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 33.00 in. $f_{sc}$ = ——— psi

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 5.25 in.

$y_2$ = 4.44 in. $d_3$ = 22.76 in.

$y_3$ = 32.45 in. $c_1$ = 9.69 in.

$d_1$ = 7.69 in. $c_2$ = 23.31 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 9.69 in.

$I_s$ = 4560 in.$^4$ ( 2C32T3 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 4,310,000 in. lbs.

Use 4 - 3" x 2" x 0.33" ∠'s Area = 6.62 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 4,275,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{co} = \frac{Mc_1}{15I_s} = 605 \text{ psi}$$

CHORD MEMBER #8 Consists of 4 - 2" x 1½" x 0.25" Angles

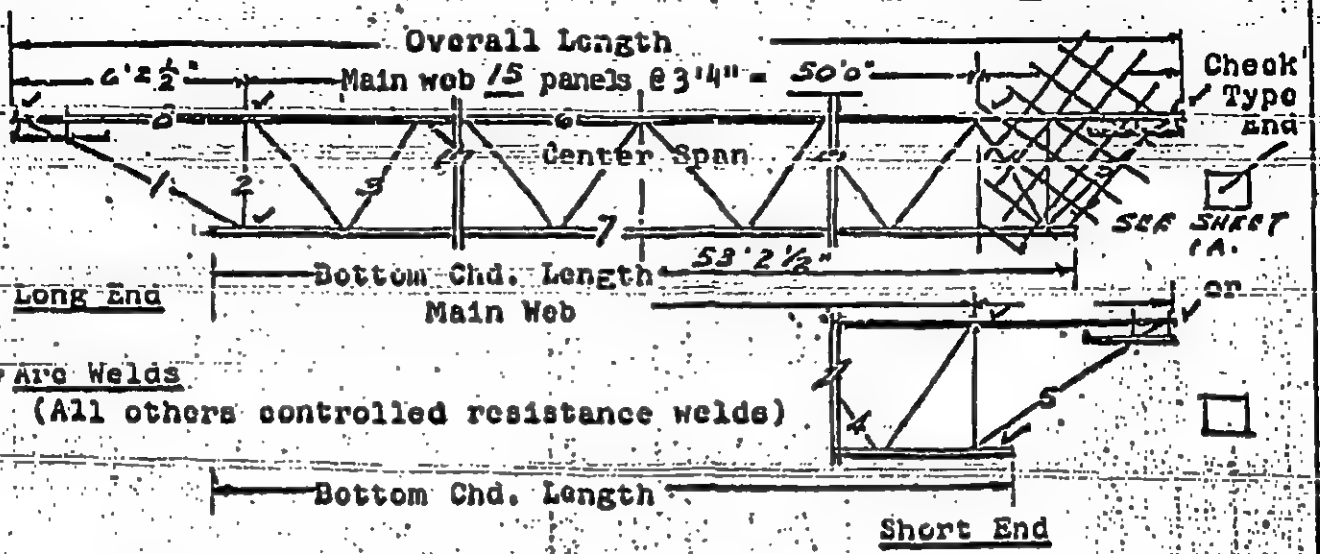
Area = 3.60 sq. in.

(SAME AS MEMBER 6)

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. 2 C32T3A - 5811

Truss Component Mk. C32T3A.




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

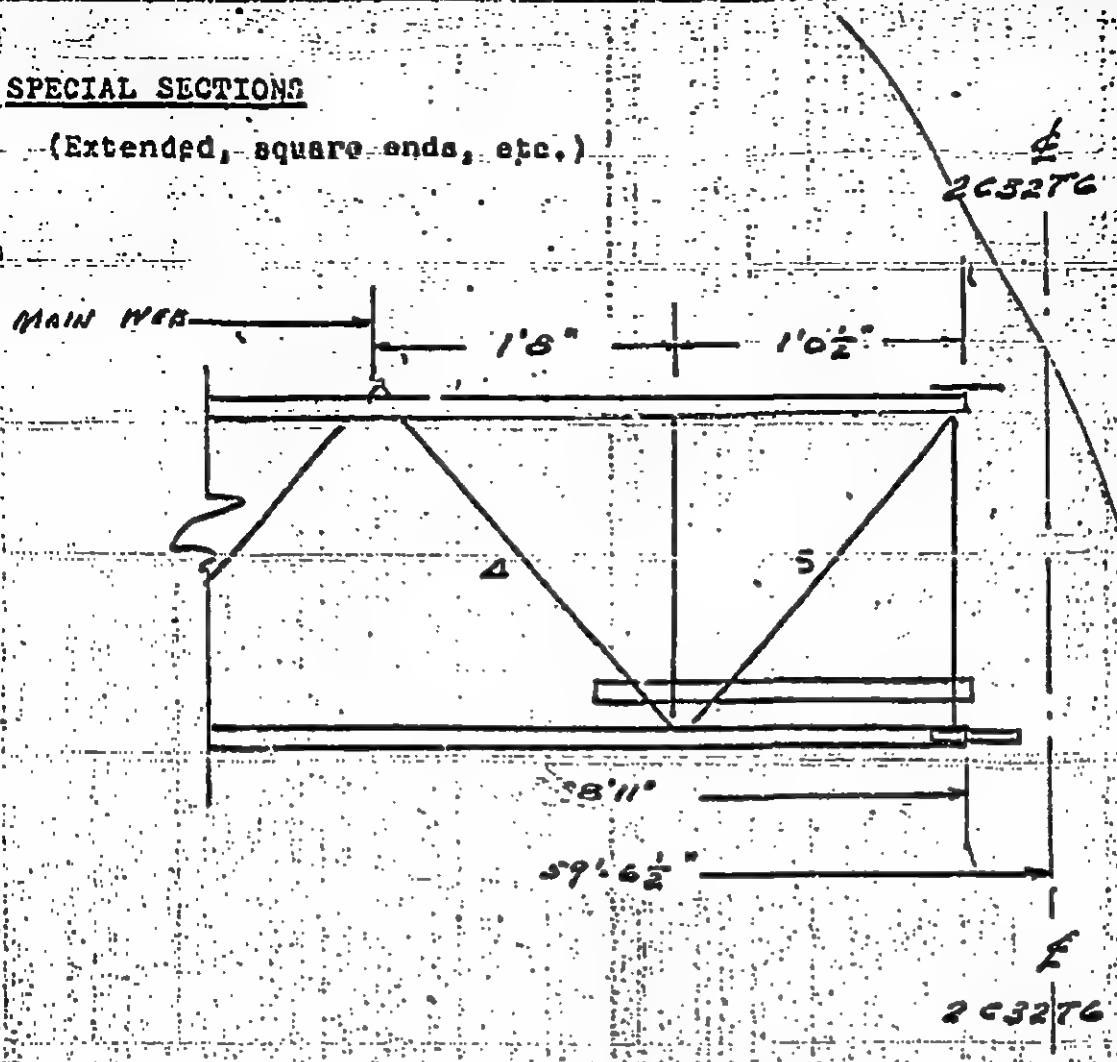
Composite Type - Webs extend above top chord 3".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C✓

| Member | Mk.No. | Grade of Steel | | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|---|
| Top Chord | 6-8 | A 441 | 2 | 2 x 1½ x .25 | 58'1" | |
| Bottom Chord | 7 | 36 | 2 | 2 x 1½ x .25 | 53'2½" | |
| Main Web | 3 | 36 | | 92" D | 91'6" | |
| Compression Web | 4 | 441 | | 98" D | 5'1" | |
| Vertical End Struts | 2 | 36 | | 92" D | 2-2'7½" & 2'3½" | |
| Long End Diagonal | 1 | 441 | | 98" D | 6'6" | |
| Short End Diagonal | 5 | 441 | | 98" D | 2'6" | |
| Top Chd. Att. Plate | | A 36 | | 9/16 x 5 (½/truss) | 9" | |
| Bott. Chd. Att. L3 | | 36 | 2 | 2 x 1½ x .25" | 1'3" | |
| " " " L6 | | 36 | 2 | 2 x 1½ x .25" | 6" | |

SPECIAL SECTIONS

(Extended, square ends, etc.)



# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

TRUSS UNIT MARKED 2C32T3A Refer to drawings ST 101, 2, 4, 6, 7.

Clearspan "L" = 59.08 ft. Spacing = 6.67 ft.

Applicable Total Moment = 1,855,000 inch pounds.

Based on — lbs./sq. ft. Total Load "w".

Applicable End Reaction = 14,000 pounds.

Based on 71 lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 1,815,000 inch pounds.

Based on 52 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 10,300 pounds.

Based on 52 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 12,580 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 12,580 lbs. $f_v$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.11 sq. in. Use 2-0.92" DIA. Area = 1.33 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 12,580 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$l$ = 26.0 in. $f_{sc}$ = 11,200 psi

Reqd. Area = 1.12 sq. in. Use 2-0.92" DIA. Area = 1.33 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 10,270 lbs. $f_y$ = 36,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 30.0 in. $f_{sc}$ = 8,750 psi

Reqd. Area = 1.36 sq. in. Use 2-0.92" DIA. Area = 1.33 sq. in.

WEB MEMBER #4 Distance from End Panel = 2.50 ft.

Applicable Shear $V_x$ = 12,820 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_b$ = — psi

$\ell$ = 30.0 in. $f_{sc}$ = 9,970 psi

Reqd. Area = 1.50 sq. in. Use 2-0.98" D. Area = 1.51 sq. in.

WEB MEMBER #5 Distance from End Panel = 1.17 ft. End = 0

Applicable Shear $V_x$ = 13,450 lbs. $f_y$ = 50,000 psi

Slope = 1.04 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 0.467 sq. in. Use 2 - 0.98" D. Area = 1.51 sq. in.

CHORD MEMBER #6 Consists of 4 ∠ 2" × 1½" × .25" Angles

Construction Load Design Area = 3.60 sq. in.

Applicable Moment = 1,815,000 in. lbs. $f_y$ = 50,000 psi

$\ell$ = 33.375 in. $f_s$ = — psi

$r_x$ = 0.44 in. $f_{sc}$ = 19,300 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{\ell}{r_x}$ = 75.8

$\frac{\ell}{2r_z}$ = 53.8

$\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \frac{f_a}{F'_e}\right)}$ = 0.995 less than 1

$f_a$ = 18000 psi

$F_a$ = 19,380 psi

$f_b$ = 843 psi

$F_b$ = 30,000 psi

$F'_e$ = 25,950 psi

Use 4 ∠ 2 × 1½ × .25" Area = 3.60 sq. in.

CHORD MEMBER #7 Consists of 4 ∠ 2 × 1½ × .25" Angles

Total Load Design Area = 3.60 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 1,855,000 in lbs. $f_y$ = 50,000 psi

$f_s$ = 30,000 psi

$D_t$ = 33.00 in. $f_{sc}$ = — psi

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 2.46 in.

$y_2$ = 4.44 in. $d_3$ = 25.66 in.

$y_3$ = 32.56 in. $c_1$ = 6.90 in.

$d_1$ = 4.90 in. $c_2$ = 26.10 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.90 in.

$I_s$ = 2,826 in.$^4$ ( 2C32 T3A )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,380,000 in. lbs.

Use 4-2"x 1½" x 0.25" ⅄'s Area = 3.60 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 1,855,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{Mc_1}{15 I_s} = 302 \text{ psi}$$

CHORD MEMBER #8 Consists of 4-2"x 1½"x 0.25" Angles

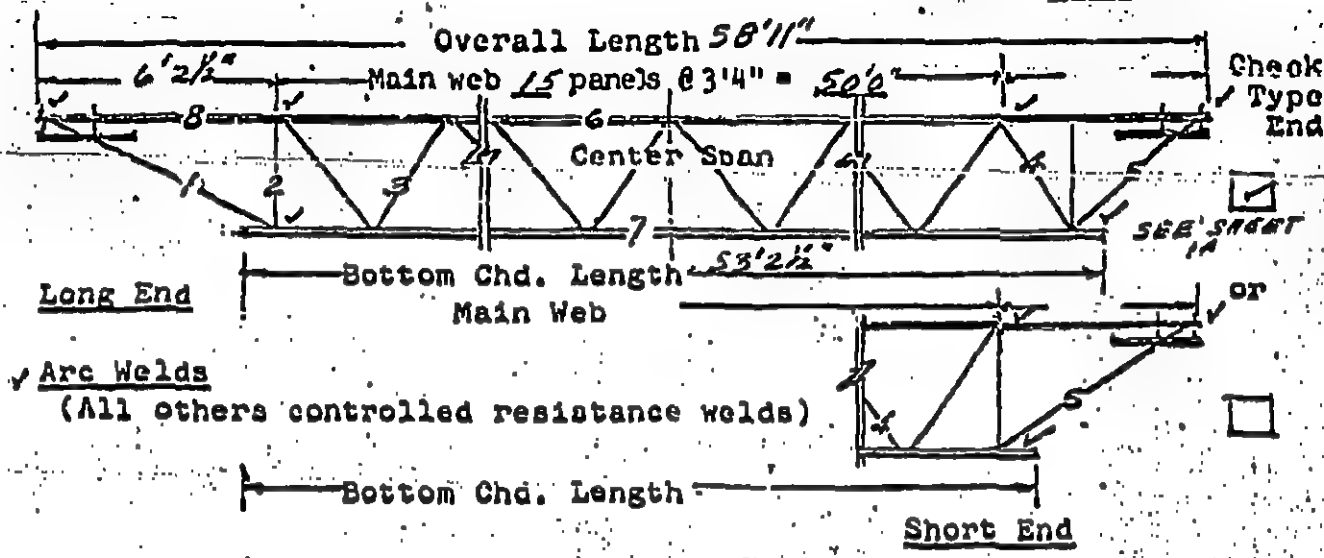
Area = 3.60 sq. in.

(SAME AS MEMBER 6)

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. C32T4-5911

Truss Component Mk. C32T4




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint ____ center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

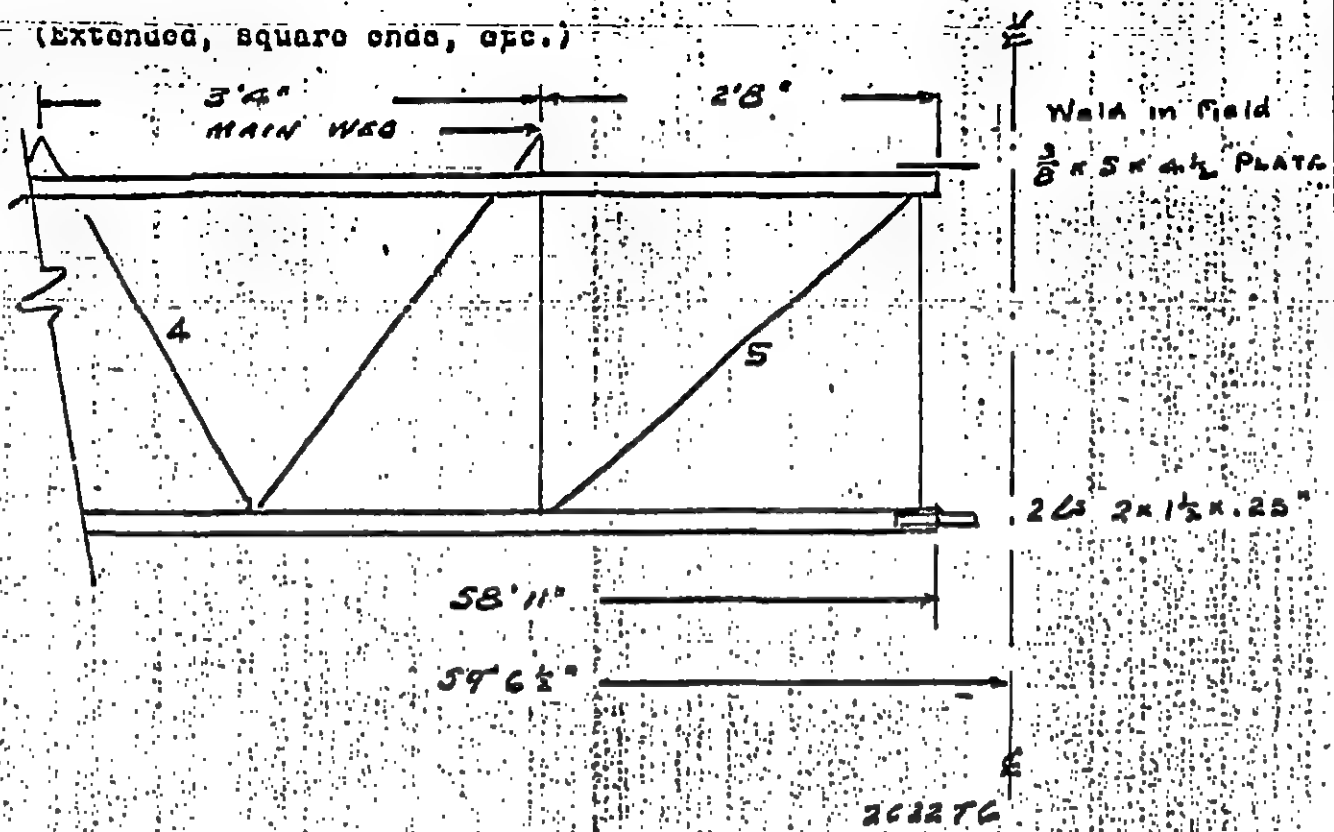
Composite Type - Webs extend above top chord 3".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C✓

| Member | Mk. No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2 L 2"x1½"x.25" | 58'11" | |
| Bottom Chord | 7 | A-36 | 2 L 2"x1½"x.25" | 53'2½" | |
| Main Web | 3 | A-441 | .98"D | 91'6" | |
| Compression Web | 4 | A-441 | .98"D | 3'1" | |
| Vertical End Struts | 2 | A-36 | .98"D | 2-2'9½" 2-2'3½" | |
| Long End Diagonal | 1 | A-441 | .92"D | 6'6" | |
| Short End Diagonal | 5 | A-36 | .92"D | 3'6" | |
| Top Chord Att. Plate | | A-36 | ⅜"x5" | 4'-4½" | |
| Bottom Chord Att. L | | A-36 | 2 L 2"x1½"x.25" | 6" | |

## SPECIAL SECTIONS

(Extended, square ends, etc.)




R = 8.00 K

$V_5 = 8.00 - \frac{24}{12}(.272) = 7.456$ K

$V_4 = V_5 - \frac{36}{12}(.272) = 6.529$ K

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED C32T4 Refer to drawings ST 101.2.4.6.7

Clearspan "L" = 59.08 ft. Spacing = 6.67 ft.

Applicable Total Moment = 500,000 inch pounds.

Based on — lbs./sq. ft. Total Load "w".

Applicable End Reaction = 8000 pounds.

Based on ____ lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = _____ inch pounds.

Based on ____ lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = _____ pounds.

Based on ____ lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 7,184 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 7,184 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = _____ psi

Reqd. Area = .635 sq. in. Use .92"D Area = .661 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 7,184 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$\ell$ = 26.0 in. $f_{sc}$ = 11,200 psi

Reqd. Area = .64 sq. in. Use .92"D Area = .661 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 5,860 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = _____ psi

$\ell$ = 30.0 in. $f_{sc}$ = 9,970 psi

Reqd. Area = .683 sq. in. Use .98"D Area = .755 sq. in.

WEB MEMBER #4 Distance from End Panel = 5.00 ft. Ed: 0

Applicable Shear $V_x$ = 6,327 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = _____ psi

$l$ = 30.0 in. $f_{sc}$ = 7,970 psi

Reqd. Area = .722 sq. in. Use .92"δ Area = .755 sq. in.

WEB MEMBER #5 Distance from End Panel = 2.00 ft.

Applicable Shear $V_x$ = 7,456 lbs. $f_y$ = 36,000 psi

Slope = 1.50 $f_s$ = 22,000 psi

$l$ = 60 in. $f_{sc}$ = _____ psi

Reqd. Area = .509 sq. in. Use .92"δ Area = .467 sq. in.

CHORD MEMBER #6 Consists of 2 L's 2 x 1½ x .25" Angles

Construction Load Design Area = 1.80 sq. in.

Applicable Moment = _____ in. lbs. $f_y$ = _____ psi

$l$ = _____ in. $f_s$ = _____ psi

$r_x$ = _____ in. $f_{sc}$ = _____ psi

$r_z$ = _____ in. (with fillers in middle 60% of span)

$\frac{l}{r_x}$ = _____

$\frac{l}{2r_z}$ = _____ $\frac{f_a}{F_a} + \frac{f_b C_m}{F_b(1-\frac{f_a}{F'_e})}$ = _____ less than 1

$f_a$ = _____ psi

$F_a$ = _____ psi

$f_b$ = _____ psi

$F_b$ = _____ psi

$F'_e$ = _____ psi

Use _____ Area = _____ sq. in.

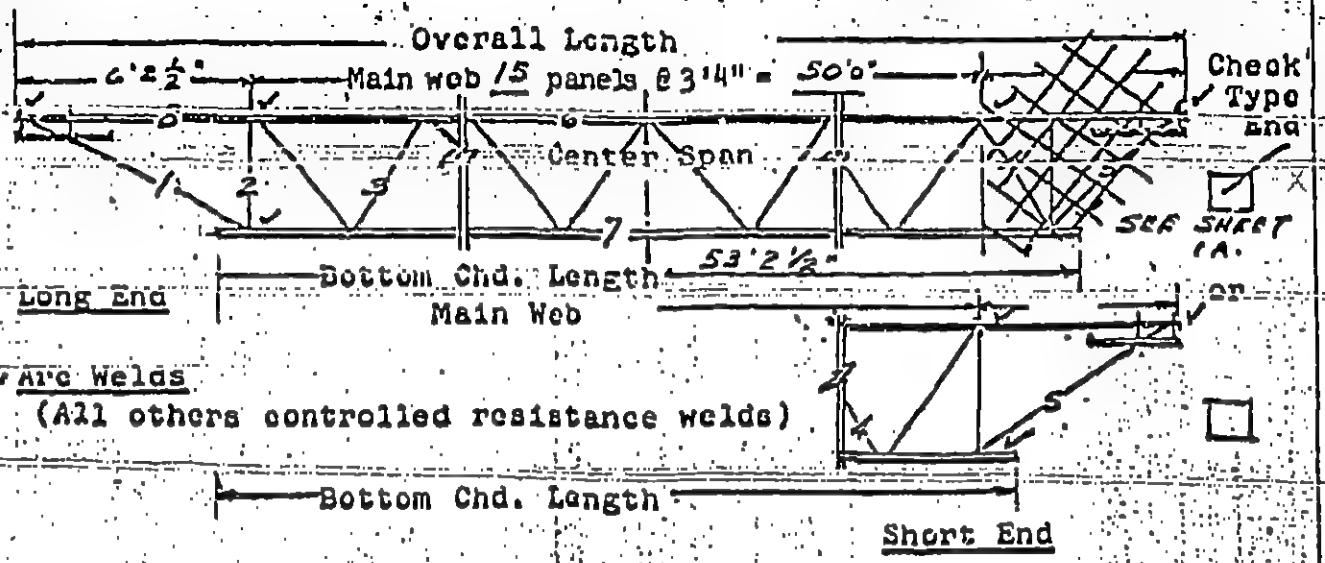
CHORD MEMBER #7 Consists of 2 L's 2 x 1½ x .25" Angles

Total Load Design Area = 1.80 sq. in.

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. 2 C 32 T 3A - 5811

Truss Component Mk. C 32 T 3A.




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 3".

MEMBERS REQUIRED PER TRUSS COMPONENT S ____ or C ✓

| Member | Mk. No. | Grade of Steel | | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|---|
| Top Chord | 6-8 | A 441 | 2 | 2 x 1½ x .25 | 58' 1" | |
| Bottom Chord | 7 | 36 | 2 | 2 x 1½ x .25 | 53' 2½" | |
| Main Web | 3 | 36 | | 92" D | 91' 6" | |
| Compression Web | 4 | A41 | | 98" D | 5' 1" | |
| Vertical End Struts | 2 | 36 | | 92" D | 2 - 2'7½" & 2 - 3'5½" | |
| Long End Diagonal | 1 | A41 | | 98" D | 6'6" | |
| Short End Diagonal | 5 | A41 | | 98" D | 2'6" | |
| Top Chd. Att. Plate | | A 36 | | 6/8 x 5 (½/truss) | 9" | |
| Bott. Chd. Att. L | | 36 | 2 | 2 x 1½ x .25 | 1'3" | |
| " " " L | | 36 | 2 | 2 x 1½ x .25 | 6" | |

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 500,000 in lbs. $f_y$ = 36000 psi

$f_s$ = 22000 psi

$D_t$ = 33.375 in. $f_{sc}$ = _____ psi

$B_{eff}$ = 64.0 in.

t = 4.0 in.

$y_1$ = 2.0 in. $d_2$ = .43 in.

$y_2$ = 4.44 in. $d_3$ = 27.69 in.

$y_3$ = 32.56 in. $c_1$ = 4.87 in.

$d_1$ = 2.87 in. $c_2$ = 28.13 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 4.87 in.

$I_s$ = 1540 in.$^4$ ( C327 4 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 1,205,000 in. lbs.

Use 2Ls 2 x 1½ x .25" Area = 1.80 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 500,000 in. lbs. $f'_c$ = 1,550 psi

$$f'_{cc} = \frac{Mc_1}{15 I_s} = 105 \text{ psi}$$

CHORD MEMBER #8 Consists of 2Ls 2 x 1½ x .25" Angles

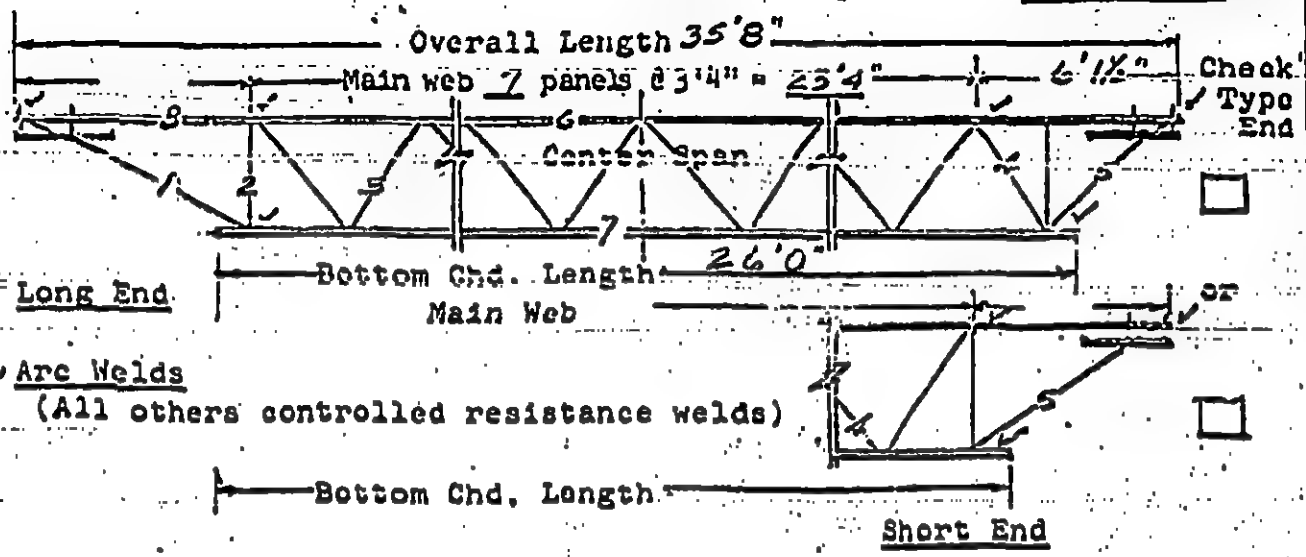
Area = 1.80 sq. in.

(SAME AS MEMBER 6)

# WORLD TRADE CENTER FLOOR GRID TRUSSES DESIGN DATA

Truss Mk. 2C32T5-358

Truss Component Mk. C32T5-358




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint NONE center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 3".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C ✓

| Member | Mk.No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2-2"x1½"x0.25"† | | |
| Bottom Chord | 7 | A-36 | 2-2"x1½"x0.25"† | | |
| Main Web | 3 | A-36 | 0.92" DIA. | | |
| Compression Web | 4 | A-441 | 0.98" DIA. | | |
| Vertical End Struts | 2 | A-36 | 0.92" DIA. | | |
| Long End Diagonal | 1 | A-441 | 0.92" DIA. | | |
| Short End Diagonal | 5 | A-441 | 0.92" DIA. | | |

SPECIAL SECTIONS

(Extended, square ends, etc.)

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32T5 Refer to drawings ST 101,6,8.

Clearspan "L" = 34.83 ft. Spacing = 6.67 ft.

Applicable Total Moment = 1,920,000 inch pounds.

Based on 154 lbs./sq. ft. Total Load "w". [31" PARTIAL LOADING]

Applicable End Reaction = 18,000 pounds.

Based on 154 lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 585,000 inch pounds.

Based on 46 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 5470 pounds.

Based on 46 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 14,920 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 14,920 lbs. $f_y$ = 30,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.32 sq. in. Use 2-0.92" DIA Area = 1.33 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 14,920 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$\ell$ = 26.0 in. $f_{sc}$ = 11,200 psi

Reqd. Area = 1.33 sq. in. Use 2-0.92" DIA Area = 1.33 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 9,920 lbs. $f_y$ = 36,000 psi

Slope = 1.162 $f_s$ = — psi

$\ell$ = 30.0 in. $f_{sc}$ = 8,750 psi

Reqd. Area = 1.32 sq. in. Use 2-0.92" DIA Area = 1.33 sq. in.

WEB MEMBER #4 Distance from End Panel = 3.21 ft. (SD = 2.00')

Applicable Shear $V_x$ = 12,570 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$\ell$ = 30.0 in. $f_{sc}$ = 9,970 psi

Reqd. Area = 1.47 sq. in. Use 2-0.98" DIA Area = 1.51 sq. in.

WEB MEMBER #5 Distance from End Panel = 0.0 ft. (SD = 2.08')

Applicable Shear $V_x$ = 15,865 lbs. $f_y$ = 50,000 psi

Slope = 1.90 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.01 sq. in. Use 2-0.92" DIA Area = 1.33 sq. in.

CHORD MEMBER #6 Consists of 4-2" x 1½" x 0.25" Angles

Construction Load Design Area = 3.60 sq. in.

Applicable Moment = 585,000 in. lbs. $f_y$ = 50,000 psi

$\ell$ = 33,375 in. $f_s$ = — psi

$r_x$ = 0.44 in. $f_{sc}$ = 12,930 psi

$r_z$ = 0.31 in. ~~(with fillers in middle 60% of span)~~

$\frac{\ell}{r_x}$ = 75.8

$\frac{\ell}{2r_z}$ = 107.5 $\frac{f_a}{F_a} + \frac{f_b C_m}{F_b(1 - \frac{f_a}{F'_e})}$ = 0.477 less than 1

$f_a$ = 5,800 psi

$F_a$ = 12,930 psi

$f_b$ = 748 psi

$F_b$ = 30,000 psi

$F'_e$ = 25,950 psi

Use 4-2" x 1½" x 0.25" ∡'s Area = 3.60 sq. in.

CHORD MEMBER #7 Consists of 4-2" x 1½" x 0.25" Angles

Total Load Design Area = 3.60 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 1,920,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 35.00 in. $f_{sc}$ = — psi

$B_{eff}$ = 64.00 in.

t = 1.00 in.

$y_1$ = 2.00 in. $d_2$ = 2.16 in.

$y_2$ = 4.44 in. $d_3$ = 25.66 in.

$y_3$ = 32.56 in. $c_1$ = 6.90 in.

$d_1$ = 4.90 in. $c_2$ = 26.10 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.90 in.

$I_s$ = 2826 $in.^4$ ( 2C32TS )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,380,000 in. lbs.

Use 4 - 2" x 1½" x 0.25" A's Area = 3.60 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 1,920,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{M_c c_1}{15 I_s} = 312 \text{ psi}$$

CHORD MEMBER #8 Consists of 4 - 2" x 1½" x 0.25" Angles

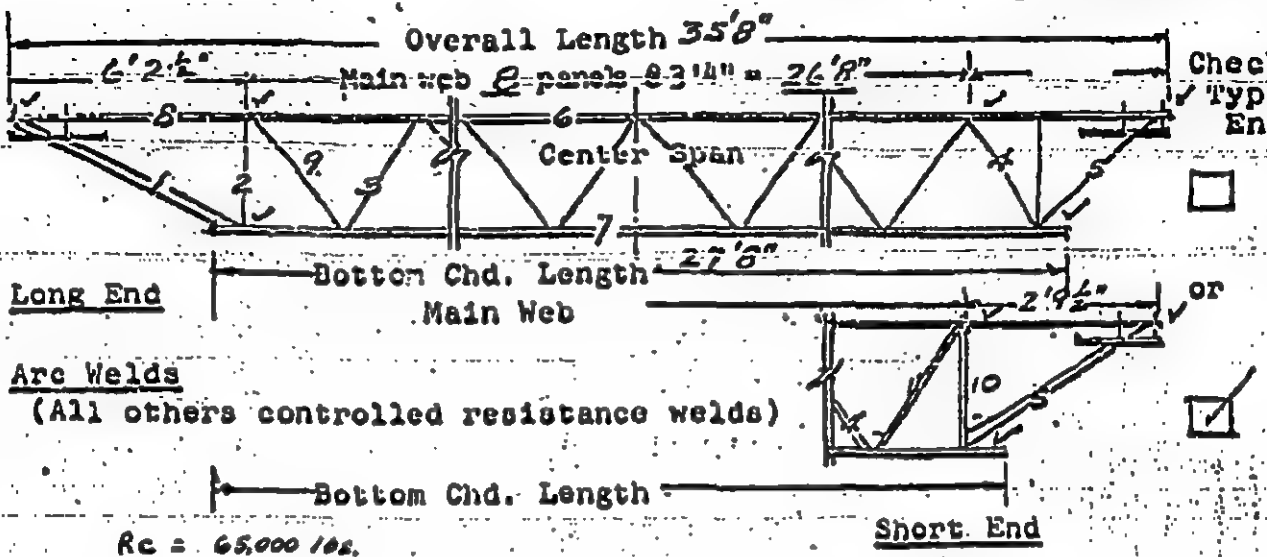
Area = 3.60 sq. in.

(SAME AS MEMBER 6)

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. 2 C32T6-358

Truss Component Mk. C32T6




✓ Arc Welds
(All others controlled resistance welds)

Rc = 65,000 lbs.
Wc = $\frac{R_c}{L}$ = 3,640 lbs.
Rw = 32,000 lbs.
Ww = $\frac{R_w}{L}$ = 1790 lbs.

NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 6 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 3".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C✓

| Member | Mk. No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2 Ls 2"x1½"x.31" | 35'8" | |
| Bottom Chord | 7 | A-36 | 2 Ls 3"x2"x.37" | 27'8" | |
| Main Web | 3 | A-441 | 1.14"D | 48'9" | |
| Compression Web | 4 | A-441 | 2 - 1.14"D | 3'1" | |
| Vertical End Struts | 2 | A-441 | 1.14"D | 2'7½" | |
| Long End Diagonal | 1 | A-441 | 1.14"D + .75"D | 6'6"-6'4" | |
| Short End Diagonal | 5 | A-441 | 1.14"D + .75"D | 3'6"-3'4" | |
| Short End Vertical | 10 | A-441 | 2 - 1.14"D | 2 - 2'7½" | |
| Short End Tension | 11 | A-441 | 1.14"D + .75"D | 3'1"-3'0" | |

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32TC Refer to drawings ST101, 4, 5, 6

Clearspan "L" = 34.83 ft. Spacing = 6.67 ft.

Applicable Total Moment = 4,720,000 inch pounds.

Based on ____ lbs./sq. ft. Total Load "w".
R. 63,000

Applicable End Reaction = R= 32,000 pounds.

Based on ____ lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 1,053,000 inch pounds.

Based on 75 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 9360 pounds.

Based on 75 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = _____ pounds. ED = _____ ft.

WEB MEMBER #1 Distance from End Panel = _____ ft.

Applicable Shear $V_x$ = 26,630 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = _____ in. $f_{sc}$ = _____ psi

Reqd. Area = 2.35 sq. in. Use 2-1.14"D Area = 2.92 sq. in.
2-.075"D

WEB MEMBER #2 Distance from End Panel = — ft.

Applicable Shear $V_x$ = 26,630 lbs. $f_y$ = 50,000 psi

Slope = 1.00 $f_s$ = _____ psi

$\ell$ = _____ in. $f_{sc}$ = 14,880 psi

Reqd. Area = 1.53 sq. in. Use 2-1.14"D Area = 2.04 sq. in.

WEB MEMBER #3 Distance from End Panel = _____ ft.

Applicable Shear $V_x$ = 17,920 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = _____ psi

$\ell$ = 295 in. $f_{sc}$ = 13,870 psi

Reqd. Area = 1.51 sq. in. Use 2-1.14"D Area = 2.04 sq. in.

WEB MEMBER #4 Distance from End Panel = — ft.

Applicable Shear $V_x$ = 48,760 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 29.5 in. $f_{sc}$ = 13,870 psi

Reqd. Area = 4.08 sq. in. Use 2 - 1.14" DIA. + 2 - 1.14" DIA. Area = 4.08 sq. in.

WEB MEMBER #5 Distance from End Panel = — ft.

Applicable Shear $V_x$ = 50,830 lbs. $f_y$ = 50,000 psi

Slope = 1.45 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 2.90 sq. in. Use 2 - 1.14" DIA. + 2 - 0.75" DIA. Area = 2.92 sq. in.

CHORD MEMBER #6 Consists of 4 - 2" x 1½" x 0.31" Angles

Construction Load Design Area = 4.30 sq. in.

Applicable Moment = 1,053,000 in. lbs. $f_y$ = 50,000 psi

$l$ = 33.375 in. $f_s$ = — psi

$r_x$ = 0.43 in. $f_{sc}$ = 19,080 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{l}{r_x}$ = 77.6

$\frac{l}{2r_z}$ = 53.8

$\frac{f_a}{F_a} + \frac{f_b C_m}{F_b(1 - \frac{f_a}{F'_e})}$ = 0.508 less than 1.

$f_a$ = 8,750 psi

$F_a$ = 19,080 psi

$f_b$ = 1,110 psi

$F_b$ = 30,000 psi

$F'_e$ = 24,750 psi

Use 4 - 2" x 1½" x 0.31" ∠'s Area = 4.30 sq. in.

CHORD MEMBER #7 Consists of 4 - 3" x 2" x 0.37" Angles

Total Load Design Area = 7.32 sq. in.

SPECIAL SECTIONS

(Extended, square ends, etc.)

MEMBER 9

Slope = 1.162 $V_x$ = 17,920 lbs. $f_y$ = 50,000 psi

$\ell$ = 29.5 in. $f_s$ = 36,000 psi

Req'd. Area = .695 sq.in. Use 2 - 1.14"D Area 2.04 sq.in

MEMBER 10

Slope = 1.00 $V_x$ = 59,830 lbs. $f_y$ = 50,000 psi

$\ell$ = 25.5 in. $f_s$ = 36,000 psi

Req'd. Area = 3.55 sq.in. Use 2 - 1.14"D Area 4.08 sq.in.

MEMBER 11

Slope = 1.162 $V_x$ = 56,700 lbs. $f_y$ = 50,000 psi

$f_s$ = 36,000 psi

Req'd. Area = 2.20 sq.in. Use 2 - 1.14"D + 2 - 0.75"D Area 2.92 sq.in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 4,730,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 53.00 in. $f_{sc}$ = ——— psi

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 5.69 in.

$y_2$ = 4.46 in. $d_3$ = 22.29 in.

$y_3$ = 32.44 in. $c_1$ = 10.15 in.

$d_1$ = 8.15 in. $c_2$ = 22.85 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 10.15 in.

$I_s$ = 2927 $in.^4$ ( 2C32T6 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 4,730,000 in. lbs.

Use 4 - 3" x 2" x 0.37" X's Area = 7.32 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 4,730,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{Mc_1}{15I_s} = 648 \text{ psi}$$

CHORD MEMBER #8 Consists of 4 - 2" x 1½" x 0.31" Angles

Area = 4.30 sq. in.

(SAME AS MEMBER 6)

WORLD TRADE CENTER
BRIDGING TRUSSES
DESIGN DATA

TRUSS UNIT MARKED C 28 T 7 Refer to drawings ST 104, 6, 9

NEGATIVE MOMENT

CHORD MEMBER #6 Consists of 2 - 2" x 1½" x 0.31" angles

Area = 2.15 sq. in.

$d_e$ = 22.98 in. $f_y$ = 50,000 psi

$f_s$ = 30,000 psi

$f_{sc}$ = —— psi

$M = A_{TCA}\ f_s\ d_e = (2.15)(30,000)(22.98)$

M = 1,470,000 in lbs.

CHORD MEMBER #7 Consists of 2 - 3" x 2" x 0.37" angles

Area = 3.66 sq. in.

$l$ = 35.25 in.

$r_x$ = 0.57 in. $f_y$ = 36,000 psi

$r_z$ = 0.94 in. $f_s$ = —— psi

$\frac{l}{r_x}$ = 61.9 $f_{sc}$ = 16,340 psi

$\frac{l}{2r_z}$ = 80.2 (With fillers where required)

$d_e$ = 22.98 in.

$M = A_{BCA}\ f_{sc}\ d_e = (3.66)(16,340)(22.98)$

M = 1,374,000 in lbs.

MAXIMUM NEGATIVE MOMENT = 1,374,000 in. lbs.

POSITIVE MOMENT

CHORD MEMBER #7 Consists of 2 - 3"x 2"x 0.37" angles

Area = 3.66 sq. in.

$D_t$ = 29.5 in. $f_y$ = 36,000 psi

$B_{eff}$ = 64.0 in. $f_s$ = 22,000 psi

t = 4.00 in. $f_{sc}$ = — psi

$y_1$ = 2.00 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 20.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$d_2$ = 0.73 in.

$$I_s = (I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3)$$

$$\bar{y} = \frac{(A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{(A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.69 in.

$I_s$ = 2,214 $in.^4$ ( C 28 T 7 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in.. lbs.

Composite Design Top Chord Check

Applicable Moment = 2,133,000 in. lbs. $f_c$ = 3,000 psi

$f'_{cc} = \frac{Mc_1}{15I_s}$ = 430 psi $f'_c$ = 1,350 psi

Maximum Positive Moment = 2,133,000 in. lbs.

Design of Web $f_y$ = 36,000 psi

Use 0.92" DIA. Area = 0.67 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 1,980,000 in lbs. $f_y$ = 36,000 psi

$D_t$ = 29.50 in. $f_s$ = 22,000 psi

$l_{eff}$ = 64.00 in. $f_{sc}$ = — psi

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 0.73 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 28.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.69 in.

$I_s$ = 2214 $in.^4$ ( C28T7 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in. lbs.

Use 2 - 3" x 2" x 0.37" ⊥ Area = 3.66 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 1,980,000 in. lbs. $f'_c$ = 1,360 psi

$$f'_{cc} = \frac{M_{c1}}{15 I_s} = 390 \text{ psi}$$

CHORD MEMBER #8 Consists of 2 - 2" x 1½" x 0.31" Angles

Area = 2.15 sq. in.

(SAME AS MEMBER 6)

WEB MEMBER #1

R = 22,000 lbs. $f_y$ = 50,000 psi

$V_1$ = 21,000 lbs. $f_s$ = 30,000 psi

Slope = 2.07 $f_{sc}$ = ——— psi

Reqd. Area = 1.45 sq. in. Use 2 - 0.98" D. Area = 1.51 in.$^2$

WORLD TRADE CENTER
BRIDGING TRUSSES
DESIGN DATA

TRUSS UNIT MARKED C28T8 Refer to drawings ST 104, 6 9

NEGATIVE MOMENT

CHORD MEMBER #6 Consists of 2 - 2" x 1½" x 0.31" angles

Area = 2.15 sq. in.

$d_e$ = 22.98 in. $f_y$ = 50,000 psi

$f_s$ = 30,000 psi

$f_{sc}$ = —— psi

$M = A_{TCA}\ f_s\ d_e = (2.15)(30.000)(22.98)$

M = 1,470,000 in lbs.

CHORD MEMBER #7 Consists of 2 - 3" x 2" x 0.37" angles

Area = 3.66 sq. in.

$l$ = 35.25 in.

$r_x$ = 0.57 in. $f_y$ = 36,000 psi

$r_z$ = 0.44 in. $f_s$ = —— psi

$\frac{l}{r_x}$ = 61.9 $f_{sc}$ = 16,340 psi

$\frac{l}{2r_z}$ = 80.2 (With fillers where required)

$d_e$ = 22.98 in.

$M = A_{BCA}\ f_{sc}\ d_e = (3.66)(16,340)(22.98)$

M = 1,374,000 in lbs.

MAXIMUM NEGATIVE MOMENT = 1,374,000 in. lbs.

POSITIVE MOMENT

CHORD MEMBER #7 Consists of 2 - 3"x 2" x 0.37" angles

Area = 3.66 sq. in.

$D_t$ = 29.5 in. $f_y$ = 36,000 psi

$B_{eff}$ = 64.0 in. $f_s$ = 22,000 psi

t = 4.00 in. $f_{sc}$ = — psi

$y_1$ = 2.00 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 28.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$d_2$ = 0.73 in.

$$I_s = (I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3)$$

$$\bar{y} = \frac{(A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{(A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.69 in.

$I_s$ = 2214 $in.^4$ ( C 2878 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in. lbs.

Composite Design Top Chord Check

Applicable Moment = 2,133,000 in. lbs. $f_c$ = 3,000 psi

$f'_c$ = 1,350 psi

$f'_{cc} = \frac{Mc_1}{15I_s}$ = 430 psi

Maximum Positive Moment = 2,133,000 in. lbs.

Design of Web $f_y$ = 36,000 psi

use 0.92" DIA. Area = 0.67 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 2,090,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$f_{sc}$ = ——— psi

$D_t$ = 29.50 in.

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 0.73 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 28.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$$I_s = \sum [(I_o + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_o y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.69 in.

$I_s$ = 2214 $in.^4$ ( C28TB )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in. lbs.

Use 2 - 3" x 2" x 0.37" Area = 7.32 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 2,090,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{oc} = \frac{M c_1}{15 I_s} = 421 \text{ psi}$$

CHORD MEMBER #8 Consists of 2 - 2" x 1½" x 0.31" Angles

Area = 2.15 sq. in.

(SAME AS MEMBER 6)

WORLD TRADE CENTER
BRIDGING TRUSSES
DESIGN DATA

TRUSS UNIT MARKED C 2 B T9 Refer to drawings ST 104.6.9.

NEGATIVE MOMENT

CHORD MEMBER #6 Consists of 2 - 2" x 1½" x 0.31" angles

Area = 2.15 sq. in.

$d_e$ = 22.98 in. $f_y$ = 50,000 psi

$f_s$ = 30,000 psi

$f_{sc}$ = — psi

$M = A_{TCA}\ f_s\ d_e = (2.15)(30,000)(22.98)$

M = 1,470,000 in lbs.

CHORD MEMBER #7 Consists of 2 - 3" x 2" x 0.37" angles

Area = 3.66 sq. in.

$\ell$ = 35.25 in.

$r_x$ = 0.57 in. $f_y$ = 36,000 psi

$r_z$ = 0.44 in. $f_s$ = — psi

$\frac{\ell}{r_x}$ = 61.9 $f_{sc}$ = 16,340 psi

$\frac{\ell}{2r_z}$ = 80.2 (With fillers where required)

$d_e$ = 22.98 in.

$M = A_{BCA}\ f_{sc}\ d_e = (3.66)(16,340)(22.98)$

M = 1,374,000 in lbs.

MAXIMUM NEGATIVE MOMENT = 1,374,000 in. lbs.

POSITIVE MOMENT

CHORD MEMBER #7 Consists of 2-3"x 2"x 0.37" angles

Area = 3.66 sq. in.

$D_t$ = 29.5 in. $f_y$ = 36,000 psi

$B_{eff}$ = 64.0 in. $f_s$ = 22,000 psi

t = 4.00 in. $f_{bc}$ = — psi

$y_1$ = 2.00 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 28.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$d_2$ = 0.73 in.

$$I_s = (I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3)$$

$$\bar{y} = \frac{(A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{(A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.69 in.

$I_s$ = 2,214 $in.^4$ ( C 28 T 9 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in. lbs.

Composite Design Top Chord Check

Applicable Moment = 2,133,000 in. lbs. $f_c$ = 3,000 psi

$f'_c$ = 1,350 psi

$f'_{cc} = \frac{Mc_1}{15I_s}$ = 430 psi

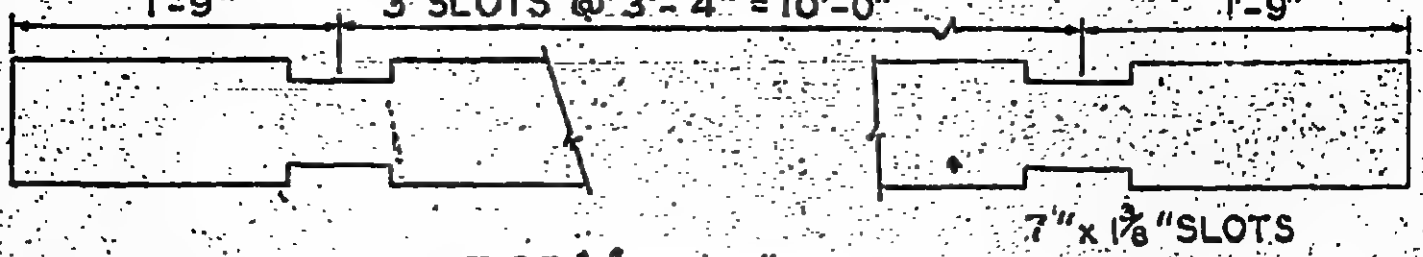
Maximum Positive Moment = 2,133,000 in. lbs.

Design of Web $f_y$ = 36,000 psi

Use 0.92" DIA. Area = 0.67 sq. in.

LACLEDE STEEL COMPANY · SAINT LOUIS, MISSOURI

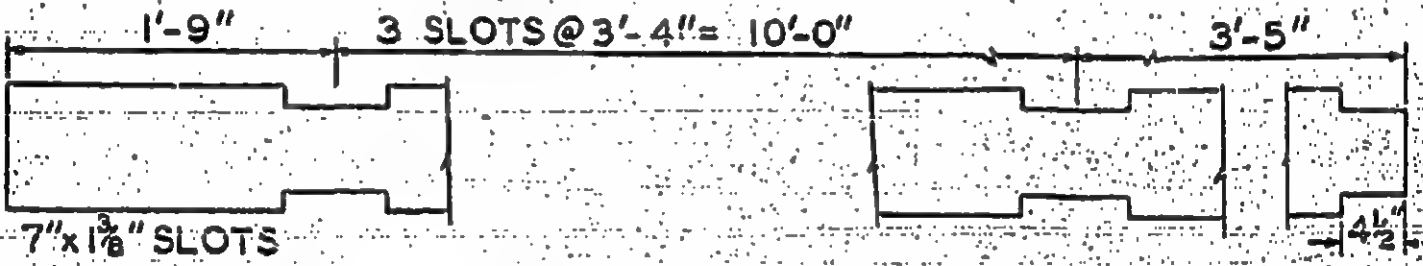
DRAWING NO. 97-111 SUBJECT COVER PLATE DETAILS
BY LWH DATE 3-6-67 WORLD TRADE CENTER TOWERS
CHKD. BY ACW DATE 3-7-67 NEW YORK N.Y.




## TYPE "A" 13'-6" LG.

8½" WIDE A
6½" WIDE $A_1$ } .0135 MIN. THICKNESS

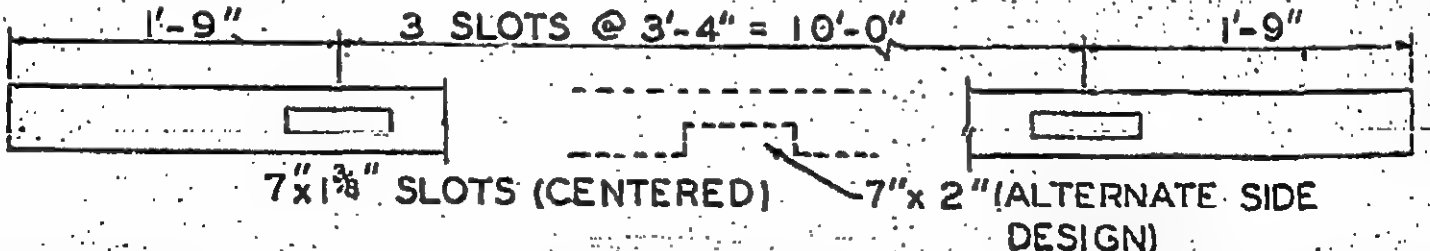
17280 PCS. 13'-6" LONG TYPE "A" REQUIRED
2880 " " " " $A_1$ "




## TYPE "B" 15'-2" LG

8½" WIDE B
6½" WIDE $B_1$ } .0135 MIN. THICKNESS

17280 PCS. 15'-2" LONG TYPE "B" REQUIRED
2880 " " " " $B_1$ "



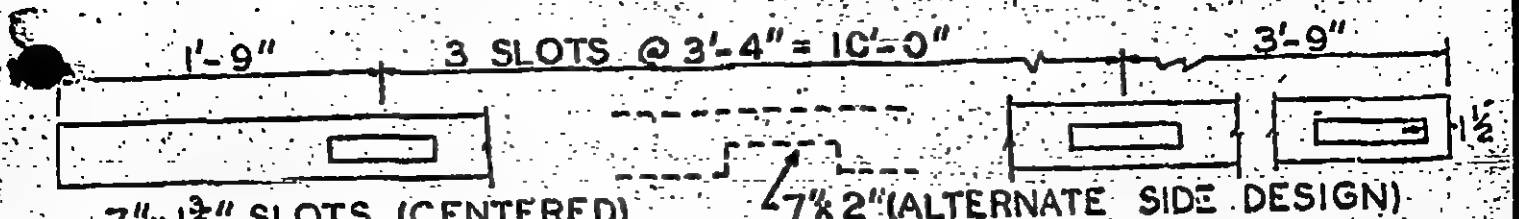

## TYPE "C" 13'-6" LG

4" WIDE
.0135 MIN. THICKNESS

1440 PCS. 13'-6" LONG TYPE "C" REQUIRED

LACLEDE STEEL COMPANY

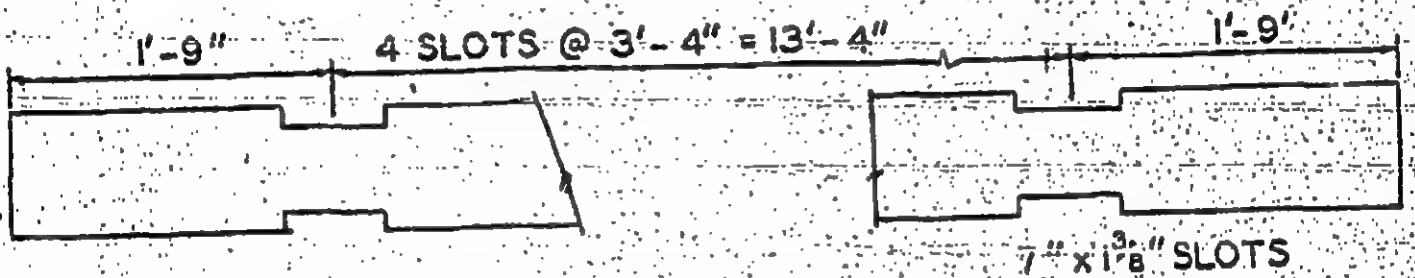
DRAWING NO. ST 112 SUBJECT COVER PLATES DETAILS
BY L.W.H. DATE 3-6-67 WORLD TRADE CENTER TOWERS
CHKD. BY A.C.W. DATE 3-7-67 NEW YORK N.Y.




TYPE "D" 15'-6" LG

4" WIDE .0135 MIN. THICKNESS

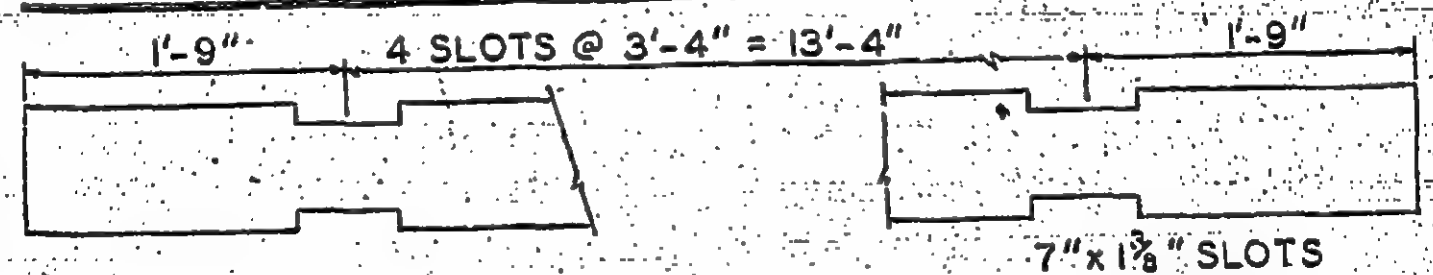
1440 PCS. 15'-6" LONG TYPE "D" REQUIRED




TYPE "E" 16'-10" LG.

6½" WIDE .0135 MIN. THICKNESS

8640 PCS. 16'-10" LONG TYPE "E" REQUIRED




TYPE "F" 16'-10" LG.

8½" WIDE .0135 MIN THICKNESS

1440 PCS. 16'-10" LONG TYPE "F" REQUIRED

| Detail No. | Title | Date Transmitted | Approved |
|---|---|---|---|
| ST-113 | 32" composite truss details<br>Typical column end bearing details - trusses CT1, 2, 3, 3A, 4, 5, and 6<br>Core end details 58'6", 58'3", and 57'7" spans - trusses CT1 and 2 - Full Scale | | |
| ST-114 | 32" composite truss details<br>Core end bearing details 59'9" and 59'8" spans - trusses CT1 and 2 - Full Scale | | |
| ST-115 | 32" composite truss details<br>Core end bearing details 59'3", 59'2", and 58'11" spans<br>Trusses CT1 and 2 - Full Scale | | |
| ST-116 | 32" composite truss details<br>Core end bearing details<br>Trusses CT5 and CT6 35'8" span<br>Full Scale | | |
| ST-117 | 28" composite truss details<br>Truss CT7 - 19'6" span<br>24" standard truss details<br>Truss ST10 - 19'6" span<br>Column end bearing detail<br>Full Scale | | |

LACLEDE STEEL COMPANY
FLOOR GRID PANEL & PANEL LOCATIONS
WORLD TRADE CENTER TOWERS
PORT OF NEW YORK AUTHORITY

| Detail No. | Title | Date Transmitted | Approved |
|---|---|---|---|
| L-100 | Typical floor plan - showing panel designation, truss location, applicable design moments and end reaction for truss design - Scale 1/8" = 1'0" | | |
| L-101 | Quarter plan - Typical floor showing panel designation, truss location, truss designation and truss web configuration Scale 1/8" = 1'0" | | |

LACLEDE STEEL COMPANY
DESIGN CALCULATIONS
WORLD TRADE CENTER TOWERS
PORT OF NEW YORK AUTHORITY


| Sheet No. | Design Data | Date Transmitted | Approved |
|---|---|---|---|
| D100-1 thru 7 | Basic Design Data | | |
| D101 | Chord Angle Properties 2" x 1/2" angles | | |
| D102 | Chord Angle Properties 3" x 2" angles | | |
| D103 | Round Web Properties | | |
| D104 | Miscellaneous Section Properties | | |
| D105-T1 | Design Data Truss Mk. 2C32T1 | | |
| D105-T2 | Design Data Truss Mk. 2C32T2 | | |
| D105-T3 | Design Data Truss Mk. 2C32T3 | | |
| D105-T3A | Design Data Truss Mk. 2C32T3A | | |
| D105-T4 | Design Data Truss Mk. 2C32T4 | | |
| D105-T5 | Design Data Truss Mk. 2C32T5 | | |
| D105-T6 | Design Data Truss Mk. 2C32T6 | | |
| D105-T7 | Design Data Truss Mk. C28T7 | | |
| D105-T8 | Design Data Truss Mk. C28T8 | | |
| D105-T9 | Design Data Truss Mk. C28T9 | | |
| D105-T10 | Design Data Truss Mk. S24T10 | | |
| D105-T11 | Design Data Truss Mk. S24T11 | | |
| D105-T12 | Design Data Truss Mk. S24T12 | | |
| D105-T13 | Design Data Truss Mk. S24T13 | | |
| D105-ET1 | Design Data Extended End Truss Mk. 2C32ET1 | | |
| D105-ET2 | Design Data Extended End Truss Mk. 2C32ET2 | | |
| D105-ET3 | Design Data Extended End Truss Mk. 2C32ET3 | | |

| Sheet No. | Design Data | Date Transmitted | Approved |
|---|---|---|---|
| D105-ET3A | Design Data Extended End Truss Mk. 2C32ET3A | | |
| D105-ET4 | Design Data Extended End Truss Mk. 2C32ET4 | | |
| D105-ET5 | Design Data Extended End Truss Mk. 2C32ET5 | | |
| D105-ET6 | Design Data Extended End Truss Mk. 2C32ET6 | | |
| D105-ET7 | Design Data Extended End Truss Mk. C28ET7 | | |
| D105-ET10 | Design Data Extended End Truss Mk. S24ET10 | | |

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# BASIC DESIGN DATA

Based on double truss units. Mark 2CT__ or 2ST__.
Single truss components. Mark CT__ or ST__.

## DIMENSIONS:

Unless specifically noted otherwise, see "ST" Details.

Truss clearspan in feet = L. Overall length of truss minus end bearings in feet (2 x 5" = 10"). Example: 59'9" overall length. Clearspan L = 59'9" minus 10" or 58'11" or 58.92'.

Length of member, clear of attachments = "$\ell$"

### Depth of Truss

Composite type "C" (Measured top of shear member to bottom of lower chord.)

Standard type "S" (Measured out to out of chord members.)

Total depth of composite section = "$D_t$"

## TOLERANCES:

Overall length 1/4"+ or 1/4"-.

Depth 1/8"+ or 1/8"-.

## LOADS:

Total load = Live load + Dead load

Applicable for composite design.

Applicable for combined slab and top chord design and bottom chord design.

Construction load = Applicable Dead load

Applicable for top and bottom chord steel design.

Dead load = Actual weight of structural system in pounds per square foot.

Live load = Assigned live load for panel area in pounds per square foot.

Design load in pounds per square foot = "w"

Applicable design load in pounds per foot equals design load in pounds per square foot times spacing of trusses in feet = . . . . . "W"

TOTAL MOMENT:

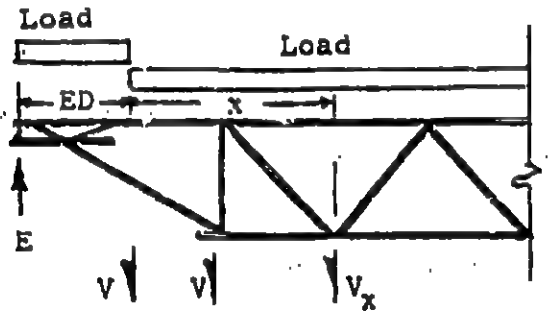
"M" (In inch pounds) = $WL^2$ x 1.5.

END REACTION:

"R" (In pounds) = "W" x .5 (overall length of truss in feet).

SHEAR:

At first top chord panel in pounds = V = R- (W x ED)

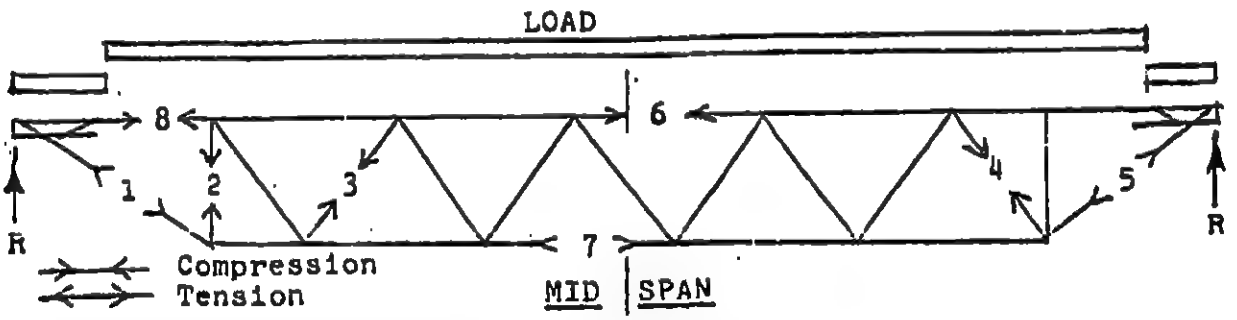



ED = Distance first top chord panel point to truss end.

Shear at other points in pounds = $V_x$ = (R- ED x W)-W (distance to first top chord panel point in feet).

(In no case less than 50% of end reaction "R".)

DESIGNATION OF MEMBERS:




1. End diagonal (long end) tension member
2. First panel vertical (long end) compression
3. Second panel compression diagonal
4. First panel vertical (short end) compression
5. End diagonal (short end) tension
6. Top chord critical compression member at mid span
7. Bottom chord critical tension member at mid span
8. End top chord compression member (long end)

MATERIALS:

A-36 steel . . . . . 36 ksi minimum yield strength

A-441 modified . . . . . 50 ksi minimum yield strength low alloy "H" Series.

See sheets D101 through D103 for Properties of Sections.

APPLICABLE FORMULAE: Stress Determination (Web or Chord Members)

A-36 steel

(36 ksi minimum yield)

$f_y$ = Minimum Yield Strength 36,000 psi

$f_s$ = Tension 22,000 psi

$f_{sc}$ = Compression for $\ell/r < 127$ $\quad 18{,}540 - .574\,(\ell/r)^2$ psi

for $\ell/r > 127$ $\quad \dfrac{149{,}000{,}000}{(\ell/4)^2}$ psi

$\ell$ = clear distance between attachments

$r$ = least radius of gyration

A-441 steel

(50 ksi minimum yield)

$f_y$ = Minimum Yield Strength 50,000 ksi

$f_s$ = Tension 30,000 psi

$f_{sc}$ = Compression for $\ell/r < 108$ $\quad 25{,}750 - 1.108\,(\ell/r)^2$ psi

for $\ell/r > 108 < 200$ $\quad \dfrac{149{,}000{,}000}{(\ell/r)^2}$ psi

Continuous members shall be designed for only axial compressive stress when the panel length clear of attachments does not exceed 24". When the panel length clear of attachments exceeds 24", the top chord shall be designed as a continuous member subject to combined axial and bending stress and shall be of proportion that the quantity -

$$\frac{f_a}{30{,}000} + \frac{f_b}{F_b}$$

does not exceed unity at the panel point, or that the quantity -

$$\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \dfrac{f_a}{F'_e}\right)}$$

does not exceed unity at the mid panel.

Permissible axial unit compressive stress = "$F_a$"

Permissible bending unit stress = "$F_b$"

Permissible compressive stress factor (column equation $\dfrac{149{,}000{,}000}{(\ell/r)^2}$ psi) = "$F'_e$"

Actual axial unit compressive stress = . . . . . $f_a$

Actual bending unit stress = . . . . . $f_b$

MAXIMUM SLENDERNESS RATIOS:

Top chord panels (main truss) = 120
End panels = 120
Compression members other than top chord = 200
Tension members = 240

FILLERS OR TIES:

Members in compression composed of two components shall have fillers or ties spaced so that the ratio of $\ell/r$ of each component shall not exceed the ratio of $\ell/r$ of the whole member. The minimum "r" shall be used in calculating the critical ratio $\ell/r$ of any component.

SHEAR CONNECTORS:

Shall be considered to provide a minimum 15 kg# horizontal shear per web end connector imbedded in the concrete. This is for 3,000 psi concrete. ($f_c$)

ok 15K ?

DEFLECTION:

Applicable deflection formula for uniform load.

Maximum deflection $\Delta = \frac{25.88\ (WL^4)}{29{,}000{,}000I}$

COMPOSITE SLAB AND JOIST DESIGN:

Design values

Total depth of combined slab and truss in inches = . . . . . $D_t$

Effective width of concrete flange in inches equal to 2 x 8t = . . . . . $B_{eff}$

Distance from top of concrete flange to neutral axis of concrete flange = . . . . . $y_1$

Distance from top of concrete flange to neutral axis of top chord angles = . . . . . $y_2$

Distance from top of concrete flange to neutral axis of bottom chord angles = . . . . . $y_3$

Distance from top of concrete flange to neutral axis of composite section = . . . . . $\bar{y}$

Distance from neutral axis of composite section to neutral axis of concrete flange = . . . . . $d_1$

Distance from neutral axis of composite section to neutral axis of top chord angles = . . . . . $d_2$

Distance from neutral axis of composite section to neutral axis of bottom chord angles = . . . . . $d_3$

Distance from neutral axis of composite section to outermost fibers of compression chord = . . . . . $c_1$

Distance from neutral axis of composite section to outermost fibers of tension chord = . . . . . $c_2$

Allowable concrete strength $f_c$ = 3,000 pounds psi.

Allowable steel strength = . . . . . $f_s$

Allowable concrete compressive stress $f'_c$ = 1,350 pounds psi.

Actual concrete compressive stress = . . . . . $f'_{cc}$

Allowable steel compressive stress = . . . . . $f_{sc}$

Modular ratio = 15 = . . . . . $\frac{E_s}{E_c}$

SECTION PROPERTIES: (Refer to Sheets D101 through D103)

Moment of inertia of concrete = . . . . . $I_c$

Moment of inertia of top chord angles = . . . . . $I_{TCA}$

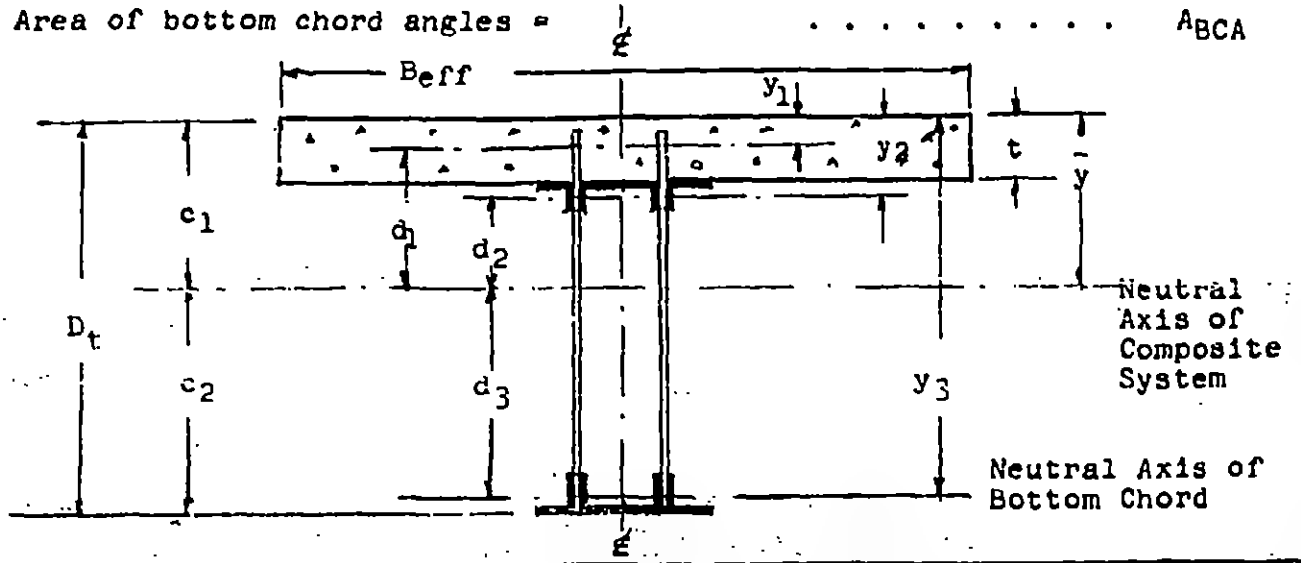
Moment of inertia of bottom chord angles = . . . . . $I_{BCA}$

Moment of inertia of composite system = . . . . . $I_S$

Area of concrete flange = . . . . . $A_c$

Area of top chord angles = . . . . . $A_{TCA}$

Area of bottom chord angles = . . . . . $A_{BCA}$



FORMULAE:

Resisting moment = "RM"

Allowable unit stress times the applicable Section Modulus = (applicable f x S).

Section Modulus (about the axis of bending) = $S = \frac{I}{C_1 \text{ or } C_2}$

QUALITY CONTROL AND INSPECTION:

Material Test Reports

Since all steel employed in the fabrication of trusses is produced in the furnaces and mills of Laclede Steel Company, certified mill test reports showing heat numbers, chemistry, and physical properties for all steel components will be provided.

Resistance Welding

Truss panel points will be connected by electronically controlled resistance welding providing two times the strength of the connected members at full design load.

Angle chords of carbon and alloy steel to be of weldable grade with contact surfaces cleaned of scale by shot blasting prior to welding.

Welds to be subject to "on-line" testing by measured hydraulic wedge action tester with spot checking of finished panel point welds by testing in vertical double shear to two times design load value.

Any panel point welds indicated to have less than the established factor for weld shear strength will be arc welded, subsequent to testing.

Full design load tests will be effected on full size and full length truss components by hydraulic loading in a test frame with load measurement by electric load cell and center span deflection check.

Load tests with recorded deflection and recovery data will be made on a minimum of one of each identified truss style involved in the panel construction.

Physical Tension Tests

Tension tests on truss components, chord angles, and webs will be performed on selected sample members included in the normal truss fabrication.

Inspection and Access to Plant

Free access to the plant of the truss manufacturer and the

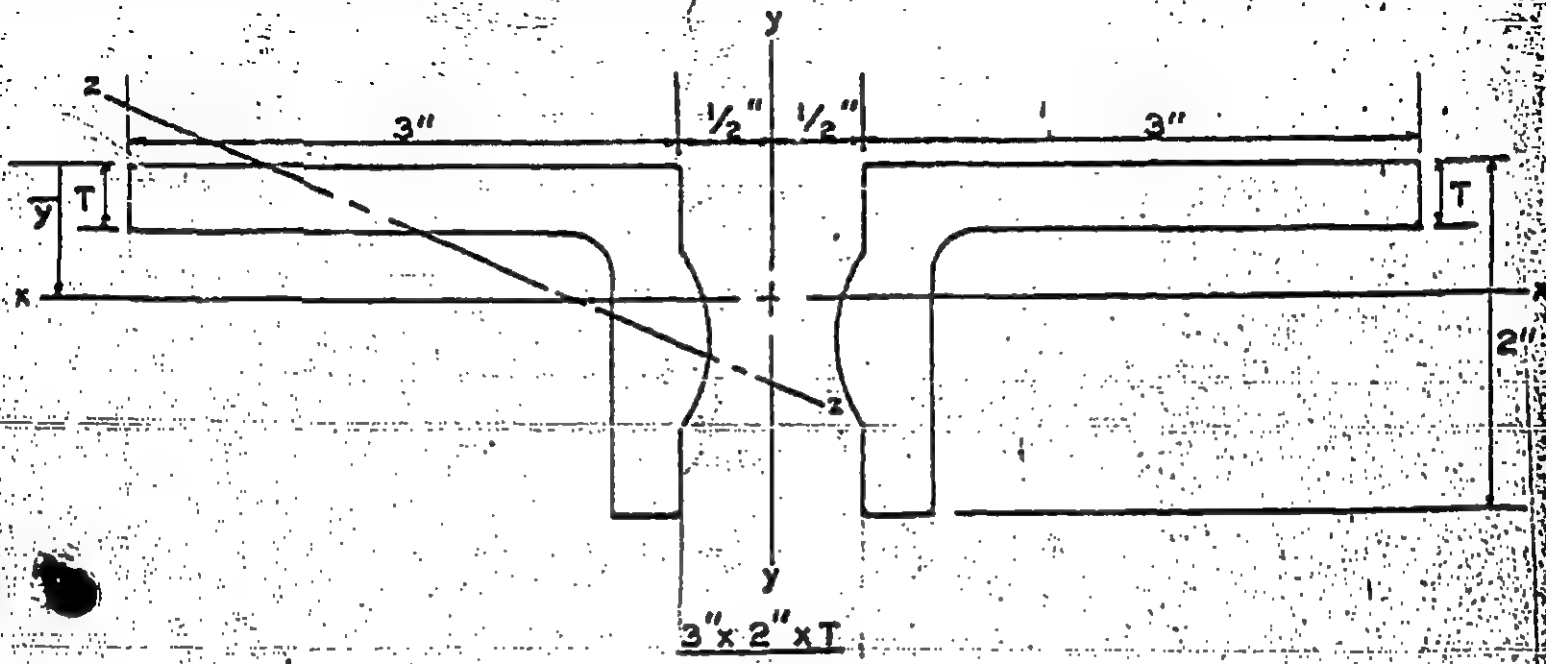
available inspection and test facilities will be offered the qualified inspectors representing the purchaser for observation of the test and inspection procedures outlined herein.

Any testing requested beyond that identified herein shall be for the account of the purchaser.

LACLEDE STEEL COMPANY SAINT LOUIS, MISSOURI

DRAWING NO. D102 SUBJECT WORLD TRADE CENTER TOWERS
BY L.J.S. DATE 2-6-67 THE PORT OF NEW YORK AUTHORITY
CHKD. BY A.C.W DATE 2-7-67

**TRUSS SECTION COMPONENTS**
**TRUSS ANGLE SECTIONS**
**DESIGN SECTION PROPERTIES**

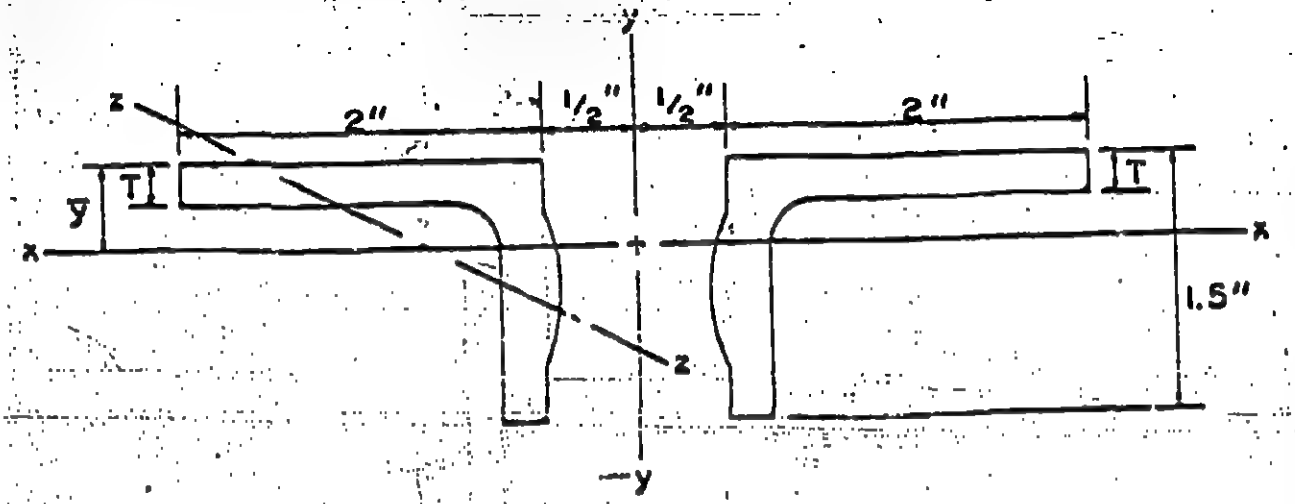



| | | | | | |
|---|---|---|---|---|---|
| T | 0.33 in | 0.37 in | | | |
| AREA | 3.31 $in^2$ | 3.66 $in^2$ | | | |
| $\bar{y}$ | 0.55 in | 0.56 in | | | |
| $I_x$ | 1.10 $in^4$ | 1.18 $in^4$ | | | |
| $I_y$ | 9.17 $in^4$ | 11.60 $in^4$ | | | |
| $r_x$ | 0.57 in | 0.57 in | | | |
| $r_y$ | 1.66 in | 1.78 in | | | |
| $r_z$ (ONE ANGLE) | 0.45 in | 0.44 in | | | |
| LBS / FT (TWO ANGLES) | 11.24 | 12.43 | | | |

LACLEDE STEEL COMPANY SAINT LOUIS, MISSOURI

DRAWING NO. D101 SUBJECT WORLD TRADE CENTER TOWERS
BY L.L.S. DATE 2-6-67 THE PORT OF NEW YORK AUTHORITY
CHKD. BY A.C.W. DATE 2-7-67

**TRUSS SECTION COMPONENTS**
**TRUSS ANGLE SECTIONS**
**DESIGN SECTION PROPERTIES**




2"x 1½" x T

| T | 0.25 in | 0.37 in | 0.37IN | 1½x1½x5 | |
|---|---|---|---|---|---|
| AREA | 1.80 in² | 2.75 in² | 2.48 | 1.24 | |
| $\bar{y}$ | 0.44 in | 0.46 in | 0.48 | 0.28 | |
| $I_x$ | 0.35 in⁴ | 0.40 in⁴ | 0.45 | 0.18 | |
| $I_y$ | 2.85 in⁴ | 3.03 in⁴ | 3.24 | | |
| $r_x$ | 0.44 in | 0.43 in | 0.42 | 0.38 | |
| $r_y$ | 1.25 in | 1.19 in | 1.13 | | |
| $r_z$ (ONE ANGLE) | 0.31 in | 0.30 in | 0.29 | 0.26 | |
| LBS/FT (TWO ANGLES) | 6.12 | 7.30 | | | |

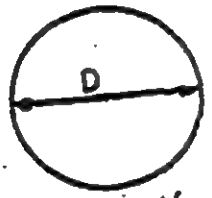
LACLEDE STEEL COMPANY SAINT LOUIS, MISSOURI

DRAWING NO. D.103 SUBJECT WORLD TRADE CENTER TOWERS

BY L.J.S DATE 2-6-67 THE PORT OF NEW YORK AUTHORITY

CHKD. BY A.C.W DATE 2-7-67

TRUSS SECTION COMPONENTS
TRUSS WEB SECTIONS
DESIGN SECTION PROPERTIES




.98

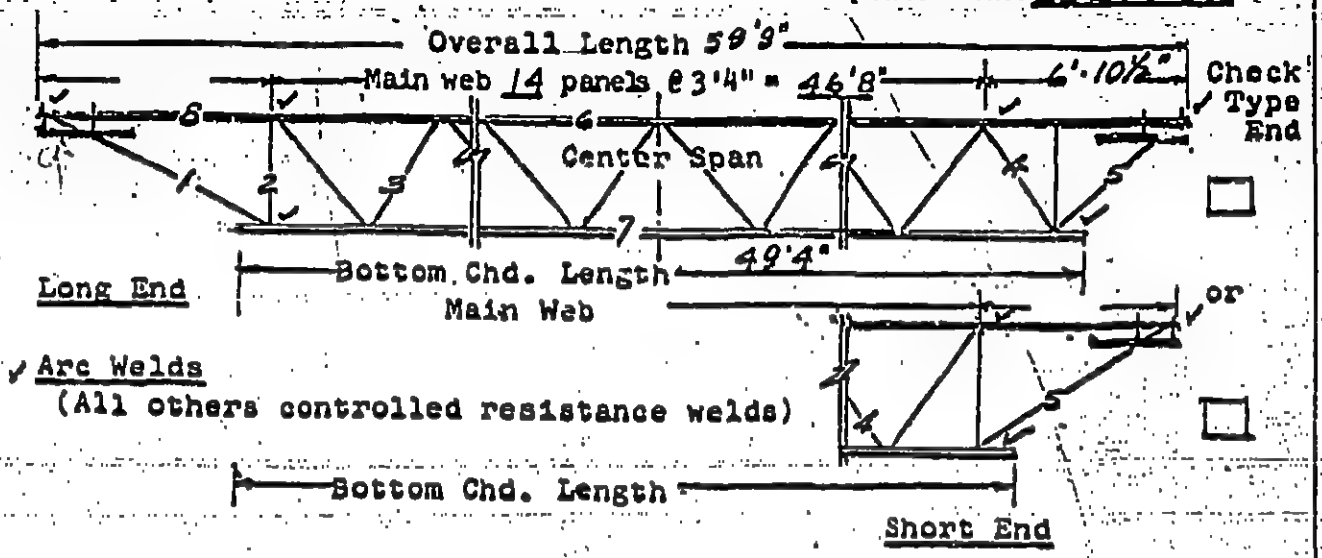
| | | | | | |
|---|---|---|---|---|---|
| DIAMETER | [illegible] in | .99 [illegible] in | [illegible] in | [illegible] in | 0.75 in |
| AREA | 0.[illegible] in² | 0.[illegible] in² .754 | 0.[illegible]33 in² | 1.0[illegible]1 in² | 0.44 in² |
| RAD. OF GYR. | 0.230 in | 0.245 in | 0.273 in | 0.285 in | 0.1875 in |
| LBS/FT | 2.26 | 2.62 | 3.17 | 3.4[illegible] | |

Revised 2-15-67

# WORLD TRADE CENTER
# FLOOR ~~GRID~~ TRUSSES
# DESIGN DATA

Truss Mk. 2C32T1-599

Truss Component Mk. C32T1-599




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3.
(Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite-Type - Webs extend above top chord 3".

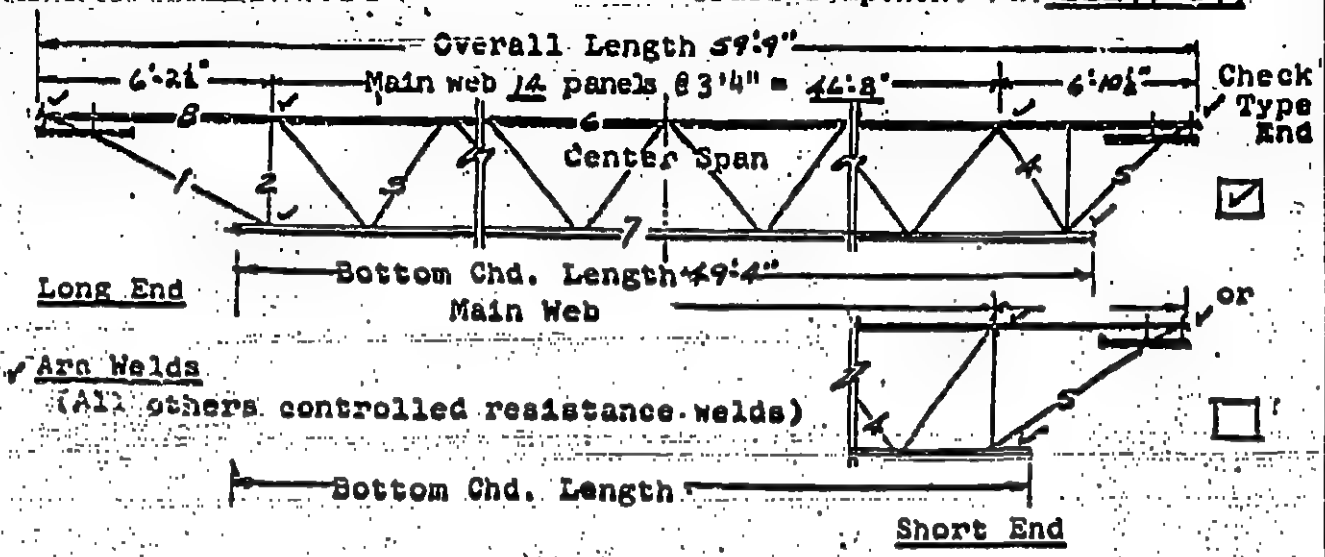
MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C-

| Member | Mk.No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2-2"x 1½"x 0.25"t | | |
| Bottom Chord | 7 | A-36 | 2-3"x 2"x 0.31"t | | |
| Main Web | 3 | A-36 | 1.09" DIA. | | |
| Compression Web | 4 | A-441 | 1.14" DIA. | | |
| Vertical End Struts | 2 | A-36 | 1.09" DIA. | | |
| Long End Diagonal | 1 | A-441 | 1.14 (1.04)" DIA. | | |
| Short End Diagonal | 5 | A-441 | 1.14" DIA. | | |

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. 2C32T1-S99

Truss Component Mk. C32T1-S99




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.
End Bearing Struts - Same size as main web.
Composite Type - Webs extend above top chord 4".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C✓

| Member | Mk. No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2-2" x 1½" x 0.25" ℄ | | |
| Bottom Chord | 7 | A-36 | 2-5" x 2" x 0.37" ℄ | | |
| Main Web | 3 | A-36 | 1.09" DIA | | |
| Compression Web | 4 | A-441 | 1.14" DIA | | |
| Vertical End Struts | 2 | A-36 | 1.09" DIA | | |
| Long End Diagonal | 1 | A-441 | 1.14" DIA | | |
| Short End Diagonal | 5 | A-441 | 1.14" DIA | | |

SPECIAL SECTIONS

(Extended, square ends, etc.)

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

TRUSS UNIT MARKED 2C32T1 Refer to drawings ST 101.6,7.

Clearspan "L" = 58.92 ft. Spacing = 6.67 ft.

Applicable Total Moment = 4,570,000 inch pounds.

Based on 128 lbs./sq. ft. Total Load "w".

Applicable End Reaction = 25,500 pounds.

Based on 128 lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 1,740,000 inch pounds.

Based on 50 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 10,000 pounds.

Based on 50 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 22,940 pounds. ED = 3.66 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 22,940 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 2.05 sq. in. Use 2-1.14" dia Area = 2.04 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 22,940 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$\ell$ = 25.5 in. $f_{sc}$ = 13,510 psi

Reqd. Area = 1.69 sq. in. Use 2-1.09" dia Area = 1.87 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 18,780 lbs. $f_y$ = 36,000 psi

Slope = 1.162 $f_s$ = — psi

$\ell$ = 29.5 in. $f_{sc}$ = 11,820 psi

Reqd. Area = 1.85 sq. in. Use 2-1.09" dia. Area = 1.87 sq. in.

WEB MEMBER #4 Distance from End Panel = 3.04 ft.

Applicable Shear $V_x$ = 20,340 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 29.5 in. $f_{sc}$ = 15,850 psi

Reqd. Area = 1.71 sq. in. Use 2-1.14" DIA Area = 2.04 sq.in.

WEB MEMBER #5 Distance from End Panel = 90 ft.

Applicable Shear $V_x$ = 22,940 lbs. $f_y$ = 50,000 psi

Slope = 2.20 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.68 sq. in. Use 2-1.14" DIA Area = 2.04 sq.in.

CHORD MEMBER #6 Consists of 4-2"x1½"x0.25" Angles

Construction Load Design Area = 3.60 sq. in.

Applicable Moment = 1,740,000 in. lbs. $f_y$ = 50,000 psi

$l$ = 33.375 in. $f_s$ = — psi

$r_x$ = 0.44 in. $f_{sc}$ = 19,380 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{l}{r_x}$ = 75.8

$\frac{l}{2r_z}$ = 53.8 $\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \frac{f_a}{F'_e}\right)}$ = 0.949 less than 1

$f_a$ = 17,260 psi

$F_a$ = 19,380 psi

$f_b$ = 810 psi

$F_b$ = 30,000 psi

$F'_e$ = 25,950 psi

Use 4-2"x1½"x0.25" A's Area = 3.60 sq. in.

CHORD MEMBER #7 Consists of 4-3"x2"x0.37" Angles

Total Load Design Area = 7.52 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 4,570,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 33.00 in. $f_{sc}$ = ____ psi

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 5.86 in.

$y_2$ = 4.44 in. $d_3$ = 22.14 in.

$y_3$ = 32.44 in. $c_1$ = 10.30 in.

$d_1$ = 8.30 in. $c_2$ = 22.70 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 10.30 in.

$I_s$ = 4913 $in.^4$ ( 2C32T1 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 4,770,000 in. lbs.

Use 4-3" x 2" x 0.37" L's Area = 7.32 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 4,570,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{M c_1}{15 I_s} = 640 \text{ psi}$$

CHORD MEMBER #8 Consists of 4-2" x 1½" x 0.25" Angles

Area = 3.60 sq. in.

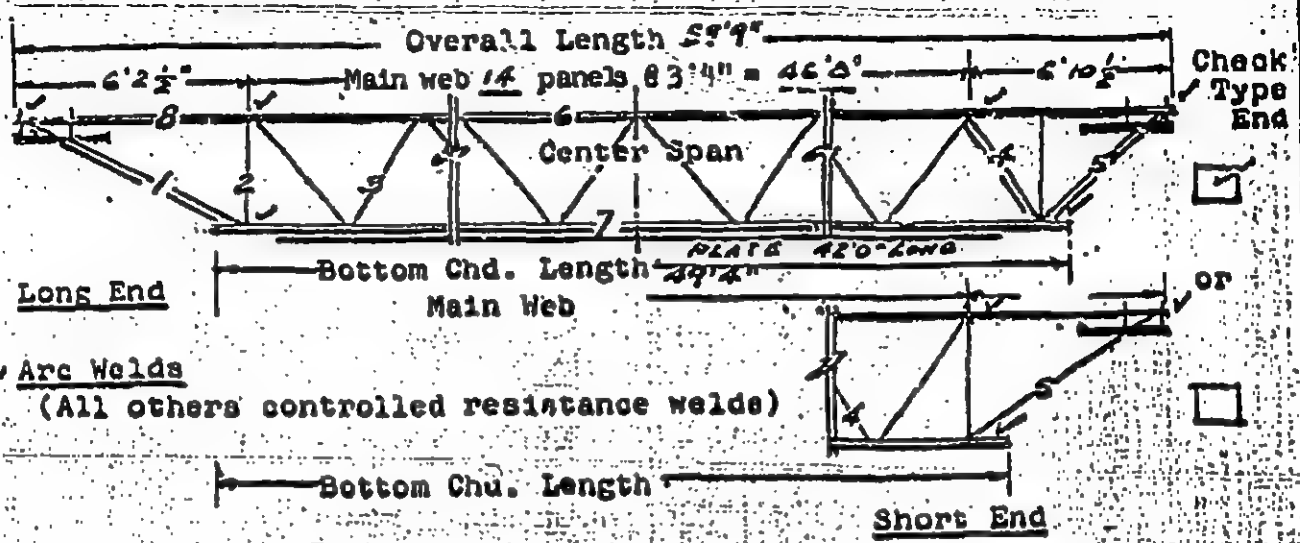
(SAME AS MEMBER 6)

LACLEDE STEEL COMPANY D105- T 2 -Sheet 1

# WORLD TRADE CENTER FLOOR GRID TRUSSES DESIGN DATA

Truss Mk. 2 C32T2-599

Truss Component Mk. C32TE-599




✓ Arc Welds
(All others controlled resistance welds)

NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.
End Bearing Struts - Same size as main web.
Composite Type - Webs extend above top chord 3".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C✓

| Member | Mk. No. | Grade of Steel | | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|---|
| Top Chord | 6-8 | A 441 | 2 | 2×1½×.31" | 59'9" | |
| Bottom Chord | 7 | 36 | 2 | 2×1½×.31" | 49'4" | |
| Main Web | 3 | 441 | | 1.14" D | 86'4" | |
| Compression Web | 4 | 441 | | 1.14" D & .75" D | 3'1", 5'0" | |
| Vertical End Struts | 2 | 441 | | 1.14" D | 2'7½", 2'3½" | |
| Long End Diagonal | 1 | 441 | | 1.14" D & .75" D | 6'6", 6'4" | |
| Short End Diagonal | 5 | 441 | | 1.14" D & .75" D | 5'8", 5'6" | |
| Bott. Chord Plate | | A 36 | | 1.3125 x 13" | 42'0" | |

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32T2 Refer to drawings ST 101,2467

Clearspan "L" = 59.06 ft. Spacing = 6.67 ft.

Applicable Total Moment = 5 630,000 inch pounds.

Based on 157 lbs./sq. ft. Total Load "w".

Applicable End Reaction = 31,300 pounds.

Based on 157 lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 1,860,000 inch pounds.

Based on 52 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 10,360 pounds.

Based on 52 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 28,150 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 28,150 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 2.49 sq. in. Use 2-1.14" DIA. + 2-0.75" DIA. Area = 2.92 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 28,150 lbs. $f_y$ = 50,000 psi

Slope = 1.00 $f_s$ = — psi

$\ell$ = 26.0 in. $f_{sc}$ = 16,530 psi

Reqd. Area = 1.84 sq. in. Use 2-1.14" DIA. Area = 2.04 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 23,050 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$\ell$ = 30.0 in. $f_{sc}$ = 13,790 psi

Reqd. Area = 1.99 sq. in. Use 2-1.14" DIA. Area = 2.04 sq. in.

WEB MEMBER #4 Distance from End Panel = 3.04 ft.

Applicable Shear $V_x$ = 24,950 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 30.0 in. $f_{sc}$ = 13,490 psi

Reqd. Area = 2.15 sq. in. Use 2-1.14" DIA. + 2-0.75" DIA. Area = 2.92 sq. in.

WEB MEMBER #5 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 28,150 lbs. $f_y$ = 50,000 psi

Slope = 2.20 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 2.06 sq. in. Use 2-1.14" DIA. + 2-0.75" DIA. Area = 2.92 sq.in.

CHORD MEMBER #6 Consists of 4-2"x1½"x0.31" Angles

Construction Load Design Area = 4.30 sq. in.

Applicable Moment = 1,860,000 in. lbs. $f_y$ = 50,000 psi

$l$ = 33.375 in. $f_s$ = — psi

$r_x$ = 0.43 in. $f_{sc}$ = 19,080 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{l}{r_x}$ = 77.6

$\frac{l}{2r_z}$ = 53.8 $\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(2 - \frac{f_a}{F'_e}\right)}$ = 0.859 less than 1

$f_a$ = 15,400 psi

$F_a$ = 19,080 psi

$f_b$ = 770 psi

$F_b$ = 30,000 psi

$F'_e$ = 24,770 psi

Use 4-2"x1½"x0.31" Angles Area = 4.30 sq. in.

CHORD MEMBER #7 Consists of ~~4-2"x1½"x0.31" Angles + 15"x5/16" PL~~

Total Load Design Area = 8.99 (4.69 + 4.30) sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 5,630,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 33.31 in. $f_{sc}$ = ——— psi

$B_{eff}$ = 64.00 in.

t = 4.00 in. $y_4$ = 33.16 in.

$d_4$ = 21.67 in.

$y_1$ = 2.00 in. $d_2$ = 7.03 in.

$y_2$ = 4.46 in. $d_3$ = 21.05 in.

$y_3$ = 32.54 in. $c_1$ = 11.49 in.

$d_1$ = 9.49 in. $c_2$ = 21.82 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 11.49 in.

$I_s$ = 5,877 in.$^4$ (2C32T2+PLATE)

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 5,920,000 in. lbs.

Use 4-2"x1½"x0.31"+2-15"x5/16"PL Area = 8.99 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 5,630,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{M c_1}{15 I_s} = 733 \text{ psi}$$

CHORD MEMBER #8 Consists of 4-2"x1½"x0.31" Angles

Area = 4.30 sq. in.

(SAME AS MEMBER 6)

CHORD MEMBER #7 (CONTD.)

Applicable Moment = _____ in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 33.00 in. $f_{sc}$ = ____ psi

$B_{eff}$ = 64.00 in.

t = 4.00 in. WITHOUT COVER PLATE

$y_1$ = 2.00 in. $d_2$ = 3.08 in.

$y_2$ = 4.46 in. $d_3$ = 25.00 in.

$y_3$ = 32.54 in. $c_1$ = 7.54 in.

$d_1$ = 5.54 in. $c_2$ = 25.46 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3^2]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 7.54 in.

$I_s$ = 3,275 in.$^4$ (2C32T2)

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,830,000 in. lbs.

Use 4-2"x1½"x0.31" ∠'s Area = 4.30 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = _____ psi

Applicable Moment = _____ in. lbs. $f'_c$ = _____ psi

$$f'_{cc} = \frac{M_{c1}}{15 I_s} = \text{_____ psi}$$

CHORD MEMBER #8 Consists of _____ Angles

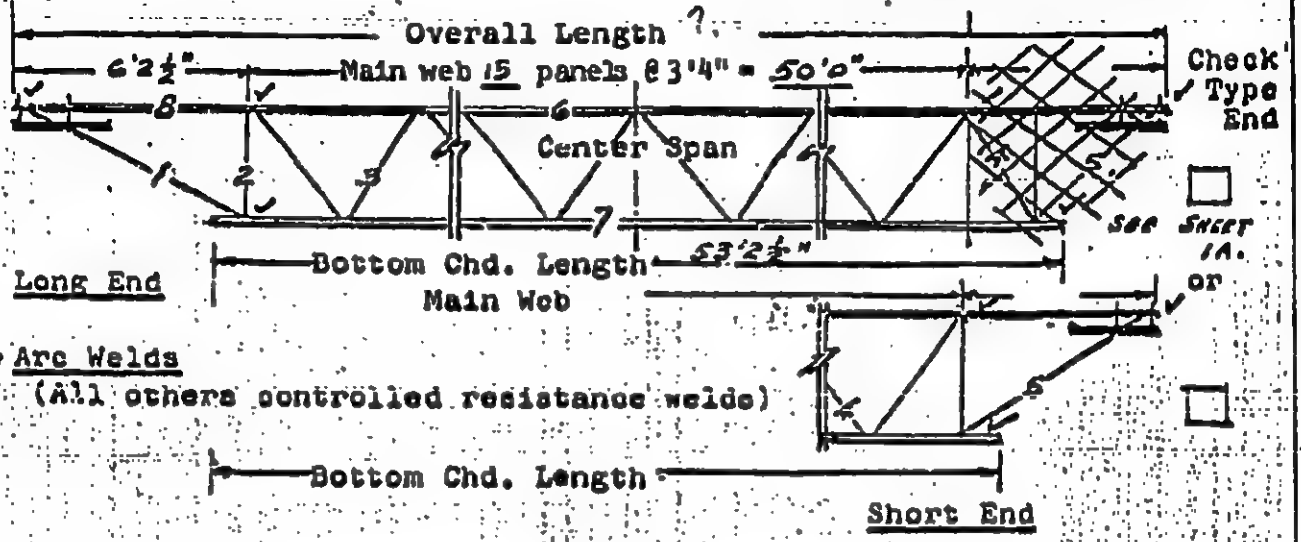
Area = _____ sq. in.

(SAME AS MEMBER 6)

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. 2C32T3 - 5811

Truss Component Mk. C32T3-5811




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

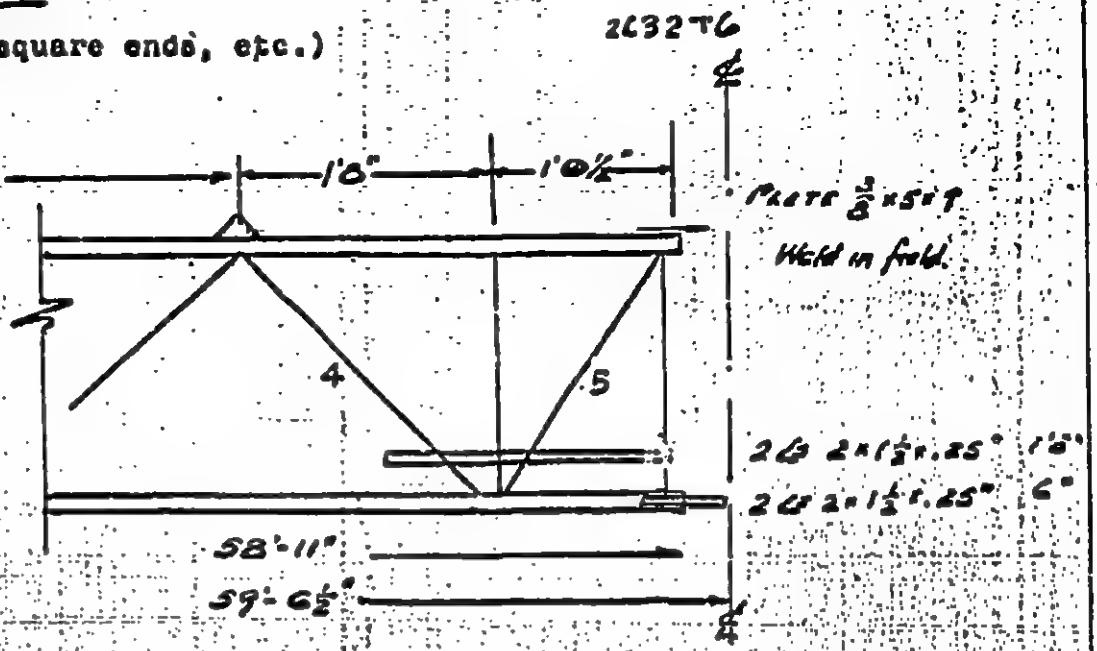
Composite Type - Webs extend above top chord 3".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C ✓

| Member | Mk. No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A 441 | 2L's 2x1½x.25 | 50'7" | |
| Bottom Chord | 7 | 36 | 2L's 3x2x.33 | 53'2½" | |
| Main Web | 3 | 36 | 1.09"D | 9'6" | |
| Compression Web | 4 | 441 | 1.14"D | 3'1" | |
| Vertical End Struts | 2 | 36 | 1.09"D | 2-2'7½" 2-4'3½" | |
| Long End Diagonal | 1 | 441 | 1.14"D | 6'6" | |
| Short End Diagonal | 5 | 441 | 1.14"D | 2'6" | |
| Top Chd Att. Plate | | A 36 | ⅜"x5" (½/Truss) | 9" | |
| Bot Chord Att. L's | | 36 | 2L's 2x1½x.25 ✓ | 1'3" | |
| " " " L's | | 36 | 2L's | 6" | |

SPECIAL SECTIONS

(Extended, square ends, etc.)




$$R = \frac{(6.67)(.121)(57.24)}{2} = 24.00\ K$$

$$V_5 = 24.0 - \frac{14}{12}(.121)(6.67) = 23.06\ K$$

$$V_4 = V_5 - \frac{16}{12}(.121)(6.67) = 21.98\ K$$

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32T3 Refer to drawings ST 10, 2, 4, 6, 7.

Clearspan "L" = 59.08 ft. Spacing = 6.67 ft.

Applicable Total Moment = 4,275,000 inch pounds.

Based on 121 lbs./sq. ft. Total Load "w".

Applicable End Reaction = 24,000 pounds.

Based on 121 lbs./sq. ft. Total Load "W".

Applicable Total Constr. Moment = 1,815,000 inch pounds.

Based on 52 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 10,300 pounds.

Based on 52 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 21,580 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 21,580 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.91 sq. in. Use 2-1.14" DIA. Area = 2.04 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 21,580 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$\ell$ = 25.5 in. $f_{sc}$ = 13,510 psi

Reqd. Area = 1.59 sq. in. Use 2-1.09" DIA. Area = 1.87 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 17,650 lbs. $f_y$ = 36,000 psi

Slope = 1.162 $f_s$ = — psi

$\ell$ = 29.5 in. $f_{sc}$ = 11,820 psi

Reqd. Area = 1.73 sq. in. Use 2-1.09" DIA. Area = 1.87 sq. in.

WEB MEMBER #4 Distance from End Panel = 2.50 ft. (ED = 0)

Applicable Shear $V_x$ = 21,980 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 29.5 in. $f_{sc}$ = 13,580 psi

Reqd. Area = 1.88 sq. in. Use 2 - 1.14" dia. Area = 2.04 sq. in.

WEB MEMBER #5 Distance from End Panel = 1.17 ft. (ED = c)

Applicable Shear $V_x$ = 23,060 lbs. $f_y$ = 50,000 psi

Slope = 1.06 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 0.815 sq. in. Use 2 - 1.14" dia. Area = 2.04 sq. in.

CHORD MEMBER #6 Consists of 4 - 2" x 1½" x 0.25" Angles

Construction Load Design Area = 3.60 sq. in.

Applicable Moment = 1,815,000 in. lbs. $f_y$ = 50,000 psi

$l$ = 33.375 in. $f_s$ = — psi

$r_x$ = 0.44 in. $f_{sc}$ = 19,380 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{l}{r_x}$ = 75.8

$\frac{l}{2r_z}$ = 53.8

$\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \frac{f_a}{F'_e}\right)}$ = 0.995 less than 1

$f_a$ = 18,000 psi

$F_a$ = 19,380 psi

$f_b$ = 843 psi

$F_b$ = 30,000 psi

$F'_e$ = 25,950 psi

Use 4 - 2" x 1½" x 0.25" Area = 3.60 sq. in.

CHORD MEMBER #7 Consists of 4 - 3" x 2" x 0.33" Angles

Total Load Design Area = 6.62 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 4,275,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 33.00 in. $f_{sc}$ = ——— psi

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 5.25 in.

$y_2$ = 4.44 in. $d_3$ = 22.76 in.

$y_3$ = 32.45 in. $c_1$ = 9.69 in.

$d_1$ = 7.69 in. $c_2$ = 23.31 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 9.69 in.

$I_s$ = 4560 in.$^4$ ( 2C32T3 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 4,310,000 in. lbs.

Use 4 - 3" x 2" x 0.33" ∠'s Area = 6.62 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 4,275,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{Mc_1}{15I_s} = 605 \text{ psi}$$

CHORD MEMBER #8 Consists of 4 - 2" x 1½" x 0.25" Angles

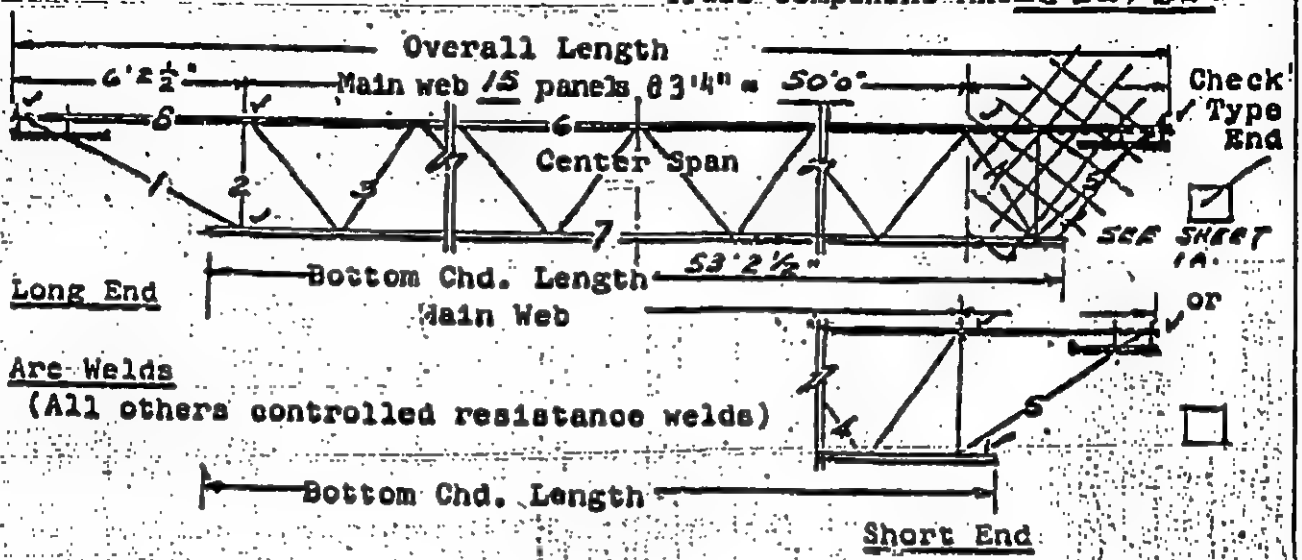
Area = 3.60 sq. in.

(SAME AS MEMBER 6)

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. 2 C32T3A - 5811

Truss Component Mk. C32T3A




**NOTES:**

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 10 center web panels minimum.)

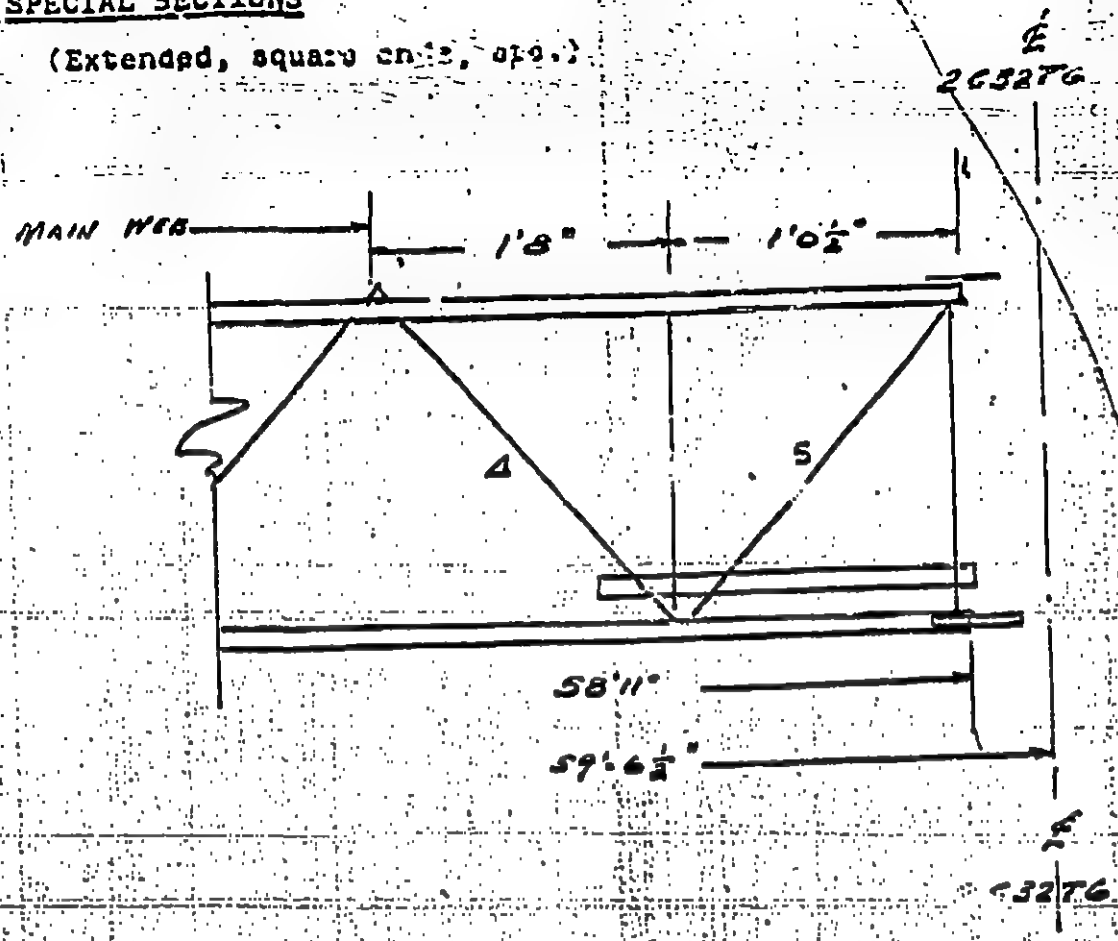
Vertical Struts Mk. 2 - Same size as main web.
End Bearing Struts - Same size as main web.
Composite Type - Webs extend above top chord 3 ".

MEMBERS REQUIRED PER TRUSS COMPONENT S ____ or C ✓

| Member | Mk.No. | Grade of Steel | | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|---|
| Top Chord | 6-8 | A 441 | 2∠s | 2×1½×.25 | 58'11" | |
| Bottom Chord | 7 | 36 | 2∠s | 2×1½×.25 | 53'2½" | |
| Main Web | 3 | 36 | | .92" D | 91'6" | |
| Compression Web | 4 | 441 | | .98" D | 3'1" | |
| Vertical End Struts | 2 | 36 | | .92" D | 2-27½" & 2'3½" | |
| Long End Diagonal | 1 | 441 | | .98" D | 6'6" | |
| Short End Diagonal | 5 | 441 | | .98" D | 2'6" | |
| Top Chd. Att. Plate | | A 36 | | 5/8×5 (½/Truss) | 9" | |
| Bott. Chd. Att. ∠s | | 36 | 2∠s | 2×1½×.25" | 1'9" | |
| " " " ∠s | | 36 | 2∠s | 2×1½×.25" | 6" | |

## SPECIAL SECTIONS

(Extended, square ends, etc.)



WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32T3A Refer to drawings ST 101, 2, 4, 6, 7.

Clearspan "L" = 59.08 ft. Spacing = 6.67 ft.

Applicable Total Moment = 1,855,000 inch pounds.

Based on — lbs./sq. ft. Total Load "w".

Applicable End Reaction = 14,000 pounds.

Based on 71 lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 1,815,000 inch pounds.

Based on 52 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 10,300 pounds.

Based on 52 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 12,580 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 12,580 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.11 sq. in. Use 2-0.92" DIA. Area = 1.33 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 12,580 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$\ell$ = 26.0 in. $f_{sc}$ = 11,200 psi

Reqd. Area = 1.12 sq. in. Use 2-0.92" DIA. Area = 1.33 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 10,270 lbs. $f_y$ = 36,000 psi

Slope = 1.162 $f_s$ = — psi

$\ell$ = 30.0 in. $f_{sc}$ = 8,750 psi

Reqd. Area = 1.36 sq. in. Use 2-0.92" DIA. Area = 1.33 sq. in.

WEB MEMBER #4 Distance from End Panel = 2.50 ft.

Applicable Shear $V_x$ = 12,820 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$\ell$ = 30.0 in. $f_{sc}$ = 9,970 psi

Reqd. Area = 1.50 sq. in. Use 2-0.98"D. Area = 1.51 sq. in.

WEB MEMBER #5 Distance from End Panel = 1.17 ft. ED = 0

Applicable Shear $V_x$ = 13,450 lbs. $f_y$ = 50,000 psi

Slope = 1.04 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = — psi

Reqd. Area = 0.467 sq. in. Use 2 - 0.98"D. Area = 1.51 sq. in.

CHORD MEMBER #6 Consists of 4 ∠ 2"x1½"x.25" Angles

Construction Load Design Area = 3.60 sq. in.

Applicable Moment = 1,815,000 in. lbs. $f_y$ = 50,000 psi

$\ell$ = 53.375 in. $f_s$ = — psi

$r_x$ = 0.44 in. $f_{sc}$ = 19,380 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{\ell}{r_x}$ = 75.8

$\frac{\ell}{2r_z}$ = 53.8 $\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \frac{f_a}{F'_e}\right)}$ = 0.995 less than 1

$f_a$ = 18,000 psi

$F_a$ = 19,380 psi

$f_b$ = 843 psi

$F_b$ = 30,000 psi

$F'_e$ = 25,950 psi

Use 4 ∠ 2 x 1½ x .25" Area = 3.60 sq. in.

CHORD MEMBER #7 Consists of 4 ∠ 2 x 1½ x .25" Angles

Total Load Design Area = 3.60 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 1,855,000 in lbs. $f_y$ = 50,000 psi

$f_s$ = 30,000 psi

$D_t$ = 33.00 in. $f_{sc}$ = —— psi

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 2.46 in.

$y_2$ = 4.44 in. $d_3$ = 25.66 in.

$y_3$ = 32.56 in. $c_1$ = 6.90 in.

$d_1$ = 4.90 in. $c_2$ = 26.10 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.90 in.

$I_s$ = 2826 $in.^4$ ( 2C32T3A )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,380,000 in. lbs.

Use 4 - 2" x 1½" x 0.25" ∠'s Area = 3.60 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 1,855,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{Mc_1}{15 I_s} = 302 \text{ psi}$$

CHORD MEMBER #8 Consists of 4 - 2" x 1½" x 0.25" Angles

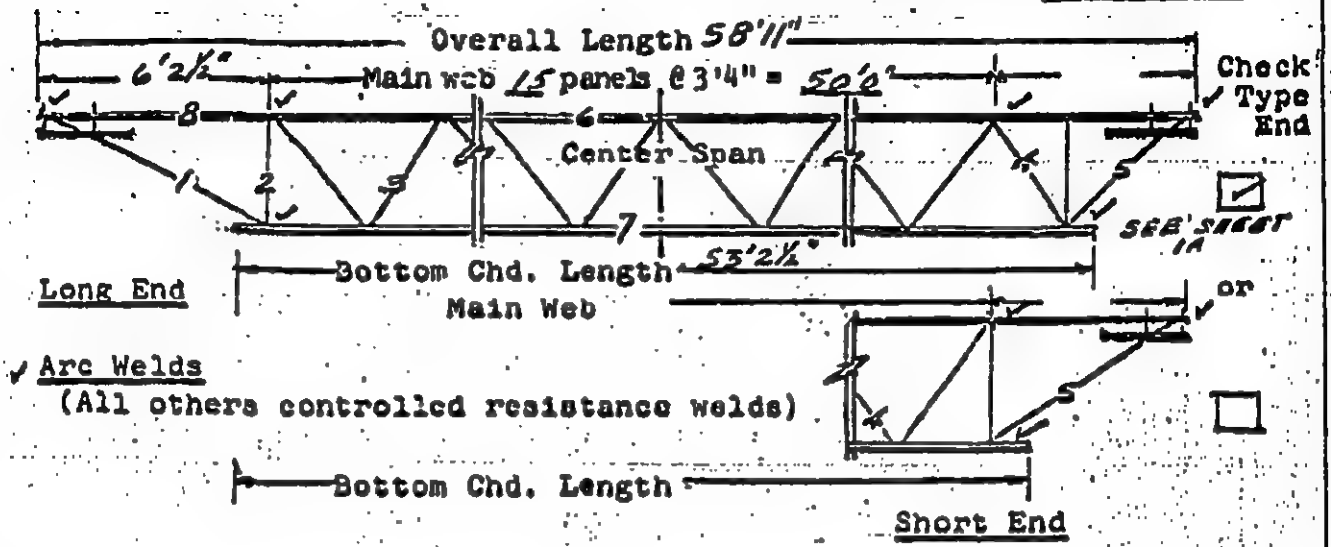
Area = 3.60 sq. in.

(SAME AS MEMBER 3)

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. C 32 T4-5811

Truss Component Mk. C 32 T4




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 3".

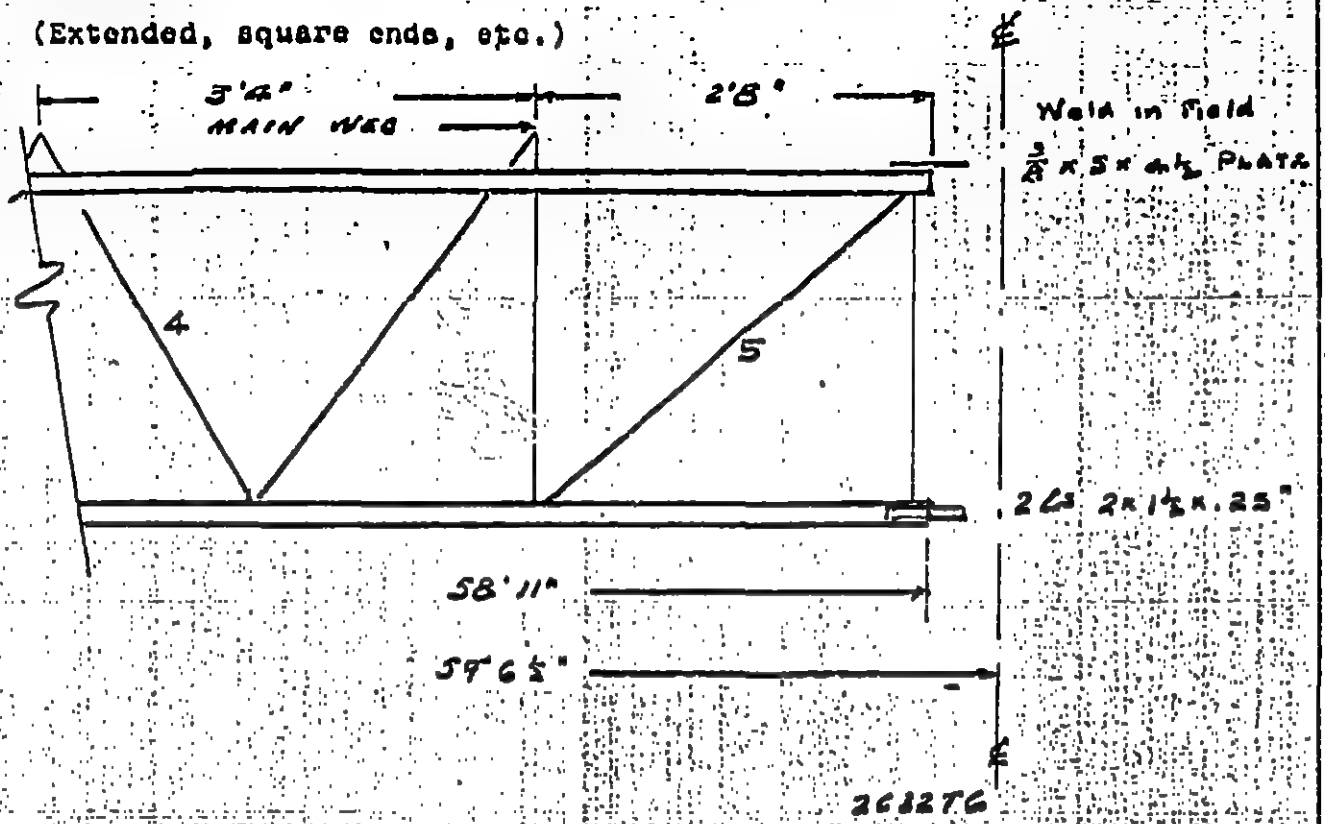
MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C✓

| Member | Mk. No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2 L 2"x1½"x.25" | 58'11" | |
| Bottom Chord | 7 | A-36 | 2 L 2"x1½"x.25" | 53'2½" | |
| Main Web | 3 | A-441 | .98" D | 91'6" | |
| Compression Web | 4 | A-441 | .98" D | 3'1" | |
| Vertical End Struts | 2 | A-36 | .98" D | 2-2'9½" 2-2'3½" | |
| Long End Diagonal | 1 | A-441 | .92" D | 6'6" | |
| Short End Diagonal | 5 | A-36 | .92" D | 3'6" | |
| Top Chord Att. Plate | | A-36 | ⅜"x5" | 4½" | |
| Bottom Chord Att. L | | A-36 | 2 L 2"x1½"x.25" | 6" | |

3 x 2 for damping

## SPECIAL SECTIONS

(Extended, square ends, etc.)




R = 8.00 K

$V_5$ = 8.00 - $\frac{24}{12}$ (.272) = 7.456 K

$V_4$ = $V_5$ = $\frac{36}{12}$ (.272) = 6.529 K

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED C32T4 Refer to drawings ST 101, 2, 4, 6, 7

Clearspan "L" = 59.08 ft. Spacing = 6.67 ft.

Applicable Total Moment = 500,000 inch pounds.

Based on — lbs./sq. ft. Total Load "w".

Applicable End Reaction = 8000 pounds.

Based on ____ lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = _____ inch pounds.

Based on ____ lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = _____ pounds.

Based on ____ lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 7,184 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 7,184 lbs. $f_y$ = 50,000 psi

Slope = 2.63 $f_s$ = 30,000 psi

$\ell$ = — in. $f_{sc}$ = _____ psi

Reqd. Area = .635 sq. in. Use .72"D Area = .661 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 7,184 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$\ell$ = 26.0 in. $f_{sc}$ = 11,200 psi

Reqd. Area = .64 sq. in. Use .92"D Area = .667 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 5,840 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = _____ psi

$\ell$ = 30.0 in. $f_{sc}$ = 9,970 psi

Reqd. Area = .683 sq. in. Use .98"D Area = .755 sq. in.

WEB MEMBER #4 Distance from End Panel = 5.00 ft. 60.0

Applicable Shear $V_x$ = 6,529 lbs. $f_y$ = 5.000 psi

Slope = 1.162 $f_s$ = _____ psi

$l$ = 30.0 in. $f_{sc}$ = 7.970 psi

Reqd. Area = .762 sq. in. Use .95"D Area = .755 sq. in.

WEB MEMBER #5 Distance from End Panel = 2.00 ft.

Applicable Shear $V_x$ = 7,456 lbs. $f_y$ = 36,000 psi

Slope = 1.50 $f_s$ = 22.000 psi

$l$ = 509 in. $f_{sc}$ = _____ psi

Reqd. Area = .509 sq. in. Use .72"S Area = .667 sq.in.

CHORD MEMBER #6 Consists of 2 L's 2 x 1½ x .25" Angles

Construction Load Design Area = 1.80 sq. in.

Applicable Moment = _____ in. lbs. $f_y$ = _____ psi

$l$ = _____ in. $f_s$ = _____ psi

$r_x$ = _____ in. $f_{sc}$ = _____ psi

$r_z$ = _____ in. (with fillers in middle 60% of span)

$\frac{l}{r_x}$ = _____

$\frac{l}{2r_z}$ = _____ $\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \frac{f_a}{F'_e}\right)}$ = _____ less than 1

$f_a$ = _____ psi

$F_a$ = _____ psi

$f_b$ = _____ psi

$F_b$ = _____ psi

$F'_e$ = _____ psi

Use _____ Area = _____ sq. in.

CHORD MEMBER #7 Consists of 2 L's 2 x 1½ x .25" Angles

Total Load Design Area = 1.80 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 500,000 in lbs. $f_y$ = 36000 psi

$f_s$ = 22000 psi

$D_t$ = 33.375 in. $f_{sc}$ = ____ psi

$B_{eff}$ = 64.0 in.

t = 4.0 in.

$y_1$ = 2.0 in. $d_2$ = .43 in.

$y_2$ = 4.44 in. $d_3$ = 27.69 in.

$y_3$ = 32.56 in. $c_1$ = 4.87 in.

$d_1$ = 2.87 in. $c_2$ = 28.13 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 4.87 in.

$I_s$ = 1540 in.$^4$ ( C3274 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 1,205,000 in. lbs.

Use 2L's 2x1½x.25" Area = 1.80 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3000 psi

Applicable Moment = 500,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{Mc_1}{15I_s} = 105 \text{ psi}$$

CHORD MEMBER #8 Consists of 2L's 2x1½x.25" Angles

Area = 1.80 sq. in.

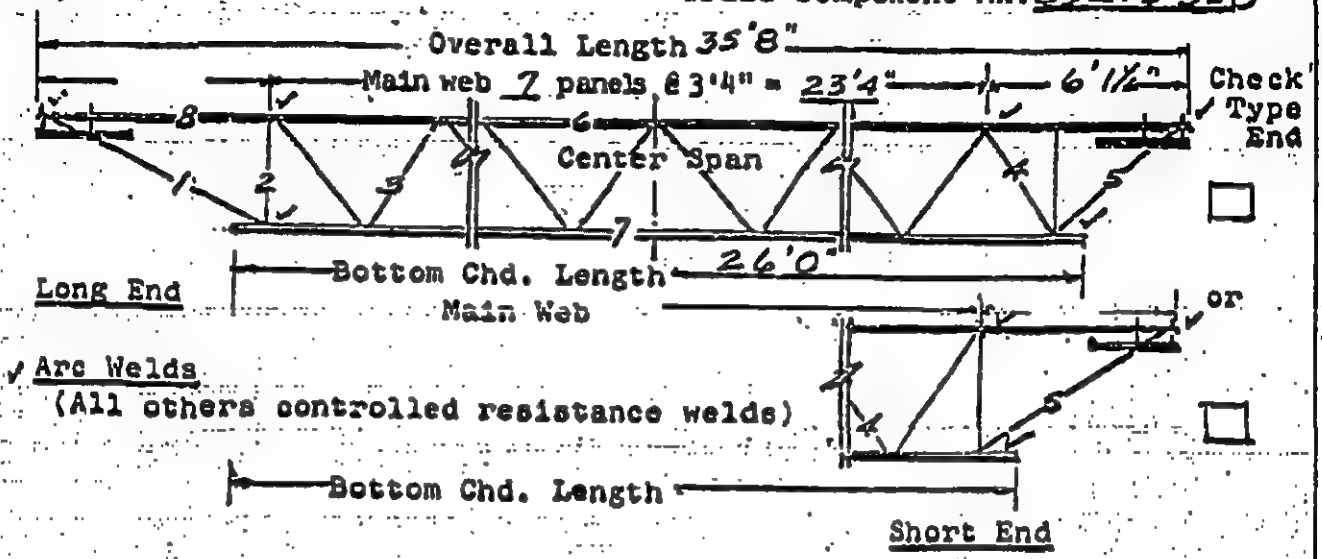
(SAME AS MEMBER 6)

REVISED 3-15-67

# WORLD TRADE CENTER
# FLOOR GRID TRUSSES
# DESIGN DATA

Truss Mk. 2C32T5-358

Truss Component Mk. C32T5-358




NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint KOALE center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 3 ".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C ✓

| Member | Mk.No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2-2" x 1½" x 0.25" ✓ | | |
| Bottom Chord | 7 | A-36 | 2-2" x 1½" x 0.25" ✓ | | |
| Main Web | 3 | A-36 | 0.92" DIA. | | |
| Compression Web | 4 | A-441 | 0.98" DIA. | | |
| Vertical End Struts | 2 | A-36 | 0.92" DIA. | | |
| Long End Diagonal | 1 | A-441 | 0.92" DIA. | | |
| Short End Diagonal | 5 | A-441 | 0.92" DIA. | | |

SPECIAL SECTIONS

(Extended, square ends, etc.)

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32T5 Refer to drawings ST 101, 6, 8.

Clearspan "L" = 34.83 ft. Spacing = 6.67 ft.

Applicable Total Moment = 1,920,000 inch pounds.

Based on 154 lbs./sq. ft. Total Load "w". [31' Partial Loading] X

Applicable End Reaction = 18,000 pounds.

Based on 154 lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 585,000 inch pounds.

Based on 46 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 5470 pounds.

Based on 46 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = 14,920 pounds. ED = 3.0 ft.

WEB MEMBER #1 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 14,920 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.32 sq. in. Use 2-0.92" DIA Area = 1.33 sq. in.

WEB MEMBER #2 Distance from End Panel = 0.0 ft.

Applicable Shear $V_x$ = 14,920 lbs. $f_y$ = 36,000 psi

Slope = 1.00 $f_s$ = — psi

$l$ = 26.0 in. $f_{sc}$ = 11,200 psi

Reqd. Area = 1.33 sq. in. Use 2-0.92" DIA Area = 1.33 sq. in.

WEB MEMBER #3 Distance from End Panel = 4.87 ft.

Applicable Shear $V_x$ = 9,920 lbs. $f_y$ = 36,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 30.0 in. $f_{sc}$ = 8,760 psi

Reqd. Area = 1.32 sq. in. Use 2-0.92" DIA Area = 1.33 sq. in.

WEB MEMBER #4 Distance from End Panel = 3.21 ft. (60 x 2.00')

Applicable Shear $V_x$ = 12,570 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_b$ = — psi

$l$ = 30.0 in. $f_{sc}$ = 9,970 psi

Reqd. Area = 1.47 sq. in. Use 2-0.98" DIA Area = 1.51 sq. in.

WEB MEMBER #5 Distance from End Panel = 0.0 ft. (50 x 2.00')

Applicable Shear $V_x$ = 15,865 lbs. $f_y$ = 50,000 psi

Slope = 1.90 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 1.01 sq. in. Use 2-0.92" DIA Area = 1.33 sq. in.

CHORD MEMBER #6 Consists of 4 - 2" x 1½" x 0.25" Angles

Construction Load Design Area = 3.60 sq. in.

Applicable Moment = 585,000 in. lbs. $f_y$ = 50,000 psi

$l$ = 35.575 in. $f_s$ = — psi

$r_x$ = 0.44 in. $f_{sc}$ = 12,930 psi

$r_z$ = 0.51 in. ~~(with fillers in middle 60% of span)~~

$\frac{l}{r_x}$ = 75.8

$\frac{l}{r_z}$ = 107.5

$\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \frac{f_a}{F'_e}\right)}$ = 0.477 less than 1

$f_a$ = 5,800 psi

$F_a$ = 12,930 psi

$f_b$ = 748 psi

$F_b$ = 30,000 psi

$F'_e$ = 25,950 psi

Use 4 - 2" x 1½" x 0.25" X's Area = 3.60 sq. in.

CHORD MEMBER #7 Consists of 4 - 2" x 1½" x 0.25" Angles

Total Load Design Area = 3.60 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 1,920,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 33.00 in. $f_{sc}$ = — psi

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 2.46 in.

$y_2$ = 4.44 in. $d_3$ = 25.66 in.

$y_3$ = 32.56 in. $c_1$ = 6.90 in.

$d_1$ = 4.90 in. $c_2$ = 26.10 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.90 in.

$I_s$ = 2826 in.$^4$ ( 2C32T5 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,380,000 in. lbs.

Use 4 - 2" x 1½" x 0.25" A's Area = 3.60 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 1,920,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{M_c c_1}{15 I_s} = 312 \text{ psi}$$

CHORD MEMBER #8 Consists of 4 - 2" x 1½" x 0.25" Angles

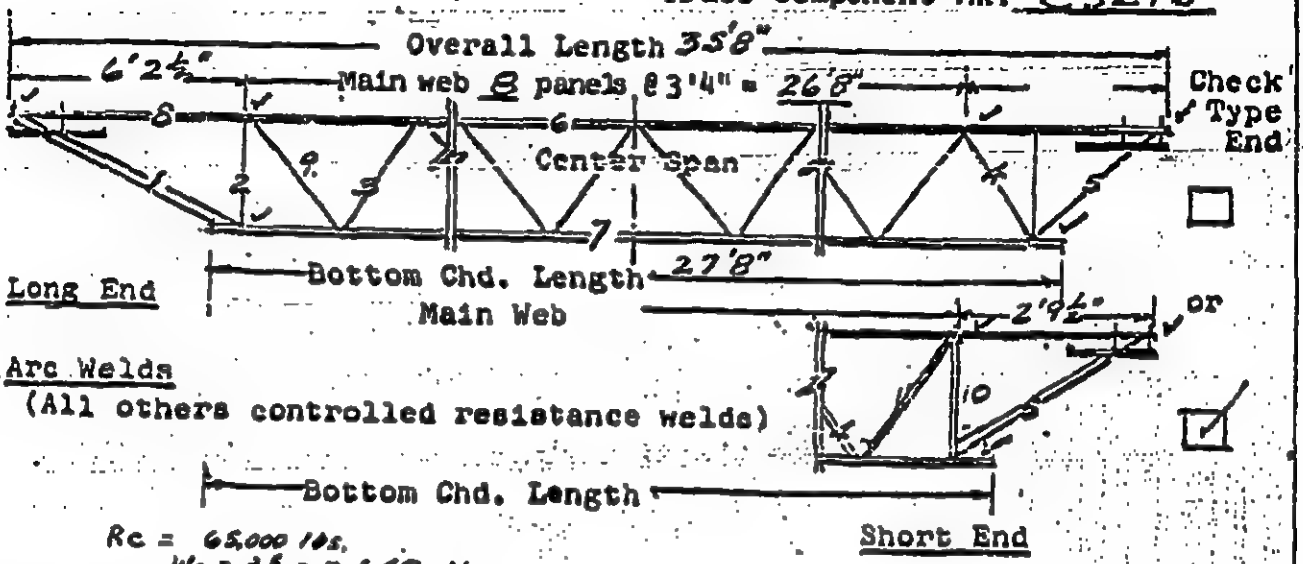
Area = 3.60 sq. in.

(SAME AS MEMBER 6)

# WORLD TRADE CENTER FLOOR GRID TRUSSES DESIGN DATA

Truss Mk: 2 C32T6-358

Truss Component Mk. C 32T6




Rc = 65,000 lbs.
Wc = 45/L = 3,640 lbs.

Rw = 32,000 lbs.
Ww = 45/L = 1,790 lbs.

NOTES:

Main Web - Continuous uniform section throughout Member Mk. 3. (Top chord fillers same section as Main Web - at midpoint 6 center web panels minimum.)

Vertical Struts Mk. 2 - Same size as main web.

End Bearing Struts - Same size as main web.

Composite Type - Webs extend above top chord 3".

MEMBERS REQUIRED PER TRUSS COMPONENT S____ or C ✓

| Member | Mk.No. | Grade of Steel | Size | Total Length Member | Weight Member |
|---|---|---|---|---|---|
| Top Chord | 6-8 | A-441 | 2 Ls 2"x1½"x.31" | 35'8" | |
| Bottom Chord | 7 | A-36 | 2 Ls 3"x2"x.37" | 27'8" | |
| Main Web | 3 | A-441 | 1.14"D | 48'9" | |
| Compression Web | 4 | A-441 | 2 - 1.14"D | 3'1" | |
| Vertical End Struts | 2 | A-441 | 1.14"D | 2'7½" | |
| Long End Diagonal | 1 | A-441 | 1.14"D x .75"D | 6'6"-6'4" | |
| Short End Diagonal | 5 | A-441 | 1.14"D x .75"D | 3'6"-3'4" | |
| Short End Vertical | 10 | A-441 | 2 - 1.14"D | 2 - 2'7½" | |
| Short End Tension | 11 | A-441 | 1.14"D x .75"D | 3'1"-3'0" | |

WORLD TRADE CENTER
FLOOR GRID TRUSSES
DESIGN DATA

TRUSS UNIT MARKED 2C32TG Refer to drawings ST101, 4, 5, 6, 8

Clearspan "L" = 34.83 ft. Spacing = 6.67 ft.

Applicable Total Moment = 4,730.000 inch pounds.

Based on ____ lbs./sq. ft. Total Load "w".

Applicable End Reaction = R = 32000 pounds. R = 63,000

Based on ____ lbs./sq. ft. Total Load "w".

Applicable Total Constr. Moment = 1,053,000 inch pounds.

Based on 75 lbs./sq. ft. Construction Load.

Applicable Constr. End Reaction = 9360 pounds.

Based on 75 lbs./sq. ft. Construction Load.

"V" Shear at End Panel = _____ pounds. ED = _____ ft.

WEB MEMBER #1 Distance from End Panel = _____ ft.

Applicable Shear $V_x$ = 26,630 lbs. $f_y$ = 50,000 psi

Slope = 2.65 $f_s$ = 30,000 psi

$\ell$ = _____ in. $f_{sc}$ = _____ psi

Reqd. Area = 2.35 sq. in. Use 2-1.14"D 2-0.75"D Area = 2.92 sq. in.

WEB MEMBER #2 Distance from End Panel = — ft.

Applicable Shear $V_x$ = 26,630 lbs. $f_y$ = 50,000 psi

Slope = 1.00 $f_s$ = _____ psi

$\ell$ = _____ in. $f_{sc}$ = 16,880 psi

Reqd. Area = 1.53 sq. in. Use 2-1.14"D Area = 2.04 sq. in.

WEB MEMBER #3 Distance from End Panel = _____ ft.

Applicable Shear $V_x$ = 17,920 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = _____ psi

$\ell$ = 29.5 in. $f_{sc}$ = 13,870 psi

Reqd. Area = 1.51 sq. in. Use 2-1.14"D Area = 2.04 sq. in.

WEB MEMBER #4 Distance from End Panel = — ft.

Applicable Shear $V_x$ = 48,760 lbs. $f_y$ = 50,000 psi

Slope = 1.162 $f_s$ = — psi

$l$ = 29.5 in. $f_{sc}$ = 13,870 psi

Reqd. Area = 4.05 sq. in. Use 2 - 1.14" DIA. + 2 - 1.14" DIA. Area = 4.08 sq. in.

WEB MEMBER #5 Distance from End Panel = — ft.

Applicable Shear $V_x$ = 59,830 lbs. $f_y$ = 50,000 psi

Slope = 1.45 $f_s$ = 30,000 psi

$l$ = — in. $f_{sc}$ = — psi

Reqd. Area = 2.90 sq. in. Use 2 - 1.14" DIA. + 2 - 0.75" DIA. Area = 2.92 sq. in.

CHORD MEMBER #6 Consists of 4 - 2" x 1½" x 0.31" Angles

Construction Load Design Area = 4.30 sq. in.

Applicable Moment = 1,053,000 in. lbs. $f_y$ = 50,000 psi

$l$ = 33.375 in. $f_s$ = — psi

$r_x$ = 0.43 in. $f_{sc}$ = 19,080 psi

$r_z$ = 0.31 in. (with fillers in middle 60% of span)

$\frac{l}{r_x}$ = 77.6

$\frac{l}{2r_z}$ = 53.8

$\frac{f_a}{F_a} + \frac{f_b C_m}{F_b\left(1 - \frac{f_a}{F'_e}\right)}$ = 0.508 less than 1.

$f_a$ = 8,750 psi

$F_a$ = 19,080 psi

$f_b$ = 1,110 psi

$F_b$ = 30,000 psi

$F'_e$ = 24,750 psi

Use 4 - 2" x 1½" x 0.31" L's Area = 4.30 sq. in.

CHORD MEMBER #7 Consists of 4 - 3" x 2" x 0.37" Angles

Total Load Design Area = 7.32 sq. in.

## SPECIAL SECTIONS

(Extended, square ends, etc.)

MEMBER 9

Slope = 1.162 $V_x$ = 17,920 lbs. $f_y$ = 50,000 psi

$\ell$ = 29.5 in. $f_s$ = 36,000 psi

Req'd. Area = .695 sq.in. Use 2-1.14"D Area 2.04 sq.in

MEMBER 10

Slope = 1.00 $V_x$ = 59,830 lbs. $f_y$ = 50,000 psi

$\ell$ = 25.5 in. $f_s$ = 36,000 psi

Req'd. Area = 3.55 sq.in. Use 2-1.14"D 2-1.14"D Area 4.08 sq.in.

MEMBER 11

Slope = 1.162 $V_x$ = 56,700 lbs. $f_y$ = 50,000 psi

$f_s$ = 36,000 psi

Req'd. Area = 2.20 sq.in. Use 2-1.14"D 2-.875"D Area 2.92 sq.in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 4,732,000 in lbs. $f_y$ = 36,000 psi

$D_t$ = 33.00 in. $f_s$ = 22,000 psi

$B_{eff}$ = 64.00 in. $f_{sc}$ = ——— psi

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 5.69 in.

$y_2$ = 4.46 in. $d_3$ = 22.29 in.

$y_3$ = 32.44 in. $c_1$ = 10.15 in.

$d_1$ = 8.15 in. $c_2$ = 22.85 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 10.15 in.

$I_s$ = 4927 in.$^4$ ( 2C32T6 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 4,740,000 in. lbs.

Use 4 - 3" x 2" x 0.37" X's Area = 7.32 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 4,730,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{Mc_1}{15I_s} = 648 \text{ psi}$$

CHORD MEMBER #8 Consists of 4 - 2" x 1½" x 0.31" Angles

Area = 4.30 sq. in.

(SAME AS MEMBER 6)

WORLD TRADE CENTER
BRIDGING TRUSSES
DESIGN DATA

TRUSS UNIT MARKED C 28 T 7 Refer to drawings ST 104, 6, 9

NEGATIVE MOMENT

CHORD MEMBER #6 Consists of 2 - 2" x 1½" x 0.31" angles

Area = 2.15 sq. in.

$d_e$ = 22.98 in. $f_y$ = 50,000 psi

$f_s$ = 30,000 psi

$f_{sc}$ = —— psi

$M = A_{TCA}\ f_s\ d_e = (2.15)(30,000)(22.98)$

M = 1,470,000 in lbs.

CHORD MEMBER #7 Consists of 2 - 3" x 2" x 0.37" angles

Area = 3.66 sq. in.

$l$ = 35.25 in.

$r_x$ = 0.57 in. $f_y$ = 36,000 psi

$r_z$ = 0.94 in. $f_s$ = —— psi

$\frac{l}{r_x}$ = 61.9 $f_{sc}$ = 16,340 psi

$\frac{l}{2r_z}$ = 80.2 (With fillers where required)

$d_e$ = 22.98 in.

$M = A_{BCA}\ f_{sc}\ d_e = (3.66)(16,340)(22.98)$

M = 1,374,000 in lbs.

MAXIMUM NEGATIVE MOMENT = 1,374,000 in. lbs.

POSITIVE MOMENT

CHORD MEMBER #7 Consists of 2 - 3" x 2" x 0.37" angles

Area = 3.66 sq. in.

$D_t$ = 29.5 in. $f_y$ = 36,000 psi

$B_{eff}$ = 64.0 in. $f_s$ = 22,000 psi

t = 4.00 in. $f_{bc}$ = ____ psi

$y_1$ = 2.00 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 28.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$d_2$ = 0.73 in.

$$I_s = (I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3)$$

$$\bar{y} = \frac{(A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{(A_c + A_{TCA} + A_{BCA})}$$

g = 6.69 in.

$I_s$ = 2,214 $in.^4$ ( C 2 8 T 7 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in. lbs.

Composite Design Top Chord Check

Applicable Moment = 2,133,000 in. lbs. $f_c$ = 3,000 psi

$f'_c$ = 1,350 psi

$f'_{cc} = \frac{Mc_1}{15I_s}$ = 430 psi

Maximum Positive Moment = 2,133,000 in. lbs.

Design of Web $f_y$ = 36,000 psi

Use 0.92" DIA. Area = 0.67 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 1,980,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 29.50 in. $f_{sc}$ = — psi

$H_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 0.73 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 28.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$$I_s = \sum [(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3]$$

$$\bar{y} = \frac{\sum (A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum (A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.69 in.

$I_s$ = 2214 $in.^4$ ( C28T7 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in. lbs.

Use 2 - 3" x 2" x 0.37" ⊥'s Area = 3.66 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 1,980,000 in. lbs. $f'_c$ = 1,360 psi

$f'_{cc} = \frac{M c_1}{15 I_s}$ = 390 psi

CHORD MEMBER #8 Consists of 2 - 2" x 1½" x 0.31" Angles

Area = 2.15 sq. in.

(SAME AS MEMBER 6)

WEB MEMBER #1

R = 22,000 lbs. $f_y$ = 50,000 psi

$V_1$ = 21,000 lbs. $f_s$ = 30,000 psi

Slope = 2.07 $f_{sc}$ = ——— psi

Reqd. Area = 1.45 sq. in. Use 2 - 0.98" D. Area = 1.51 $in.^2$

WORLD TRADE CENTER
BRIDGING TRUSSES
DESIGN DATA

TRUSS UNIT MARKED C 28 T 8 Refer to drawings ST 104, 6, 9

NEGATIVE MOMENT

CHORD MEMBER #6 Consists of 2 - 2" x 1½" x 0.31" angles

Area = 2.15 sq. in.

$d_e$ = 22.98 in. $f_y$ = 50,000 psi

$f_s$ = 30,000 psi

$f_{sc}$ = —— psi

$M = A_{BCA}\ f_s\ d_e = (2.15)(30.000)(22.98)$

M = 1,470,000 in lbs.

CHORD MEMBER #7 Consists of 2 - 3" x 2" x 0.37" angles

Area = 3.66 sq. in.

$\ell$ = 35.25 in.

$r_x$ = 0.57 in. $f_y$ = 36,000 psi

$r_z$ = 0.44 in. $f_s$ = —— psi

$\frac{\ell}{r_x}$ = 61.9 $f_{sc}$ = 16,340 psi

$\frac{\ell}{2r_z}$ = 80.2 (With fillers where required)

$d_e$ = 22.98 in.

$M = A_{BCA}\ f_{sc}\ d_e = (3.66)(16,340)(22.98)$

M = 1,374,000 in lbs.

MAXIMUM NEGATIVE MOMENT = 1,374,000 in. lbs.

POSITIVE MOMENT

CHORD MEMBER #7 Consists of 2 - 3" x 2" x 0.37" angles

Area = 3.66 sq. in.

$D_t$ = 29.5 in. $f_y$ = 36,000 psi

$B_{eff}$ = 64.0 in. $f_s$ = 22,000 psi

t = 4.00 in. $f_{sc}$ = ____ psi

$y_1$ = 2.00 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 28.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$d_2$ = 0.73 in.

$$I_s = (I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3)$$

$$\bar{y} = \frac{(A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{(A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.69 in.

$I_s$ = 2,214 in.$^4$ ( C 28T8 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in. lbs.

Composite Design Top Chord Check

Applicable Moment = 2,133,000 in. lbs. $f_c$ = 3,000 psi

$f'_c$ = 1,350 psi

$f'_{cc} = \frac{Mc_1}{15I_s}$ = 430 psi

Maximum Positive Moment = 2,133,000 in. lbs.

Design of Web $f_y$ = 36,000 psi

Use 0.92" DIA. Area = 0.67 sq. in.

CHORD MEMBER #7 (CONTD.)

Applicable Moment = 2,090,000 in lbs. $f_y$ = 36,000 psi

$f_s$ = 22,000 psi

$D_t$ = 29.50 in. $f_{sc}$ = —— psi

$B_{eff}$ = 64.00 in.

t = 4.00 in.

$y_1$ = 2.00 in. $d_2$ = 0.73 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 28.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$$I_s = \sum\left[(I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3\right]$$

$$\bar{y} = \frac{\sum(A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{\sum(A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.69 in.

$I_s$ = 2214 in.$^4$ ( C28T8 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in. lbs.

Use 2 - 3" x 2" x 0.37" ∠'s Area = 7.32 sq. in.

Composite Design Top Chord Check

Total Load Design $f_c$ = 3,000 psi

Applicable Moment = 2,090,000 in. lbs. $f'_c$ = 1,350 psi

$$f'_{cc} = \frac{M_{c1}}{15 I_s} = 421 \text{ psi}$$

CHORD MEMBER #8 Consists of 2 - 2" x 1½" x 0.31" Angles

Area = 2.15 sq. in.

(SAME AS MEMBER 6)

WORLD TRADE CENTER
BRIDGING TRUSSES
DESIGN DATA

TRUSS UNIT MARKED C 2 B T 9 Refer to drawings ST 104.6.9

NEGATIVE MOMENT

CHORD MEMBER #6 Consists of 2 - 2" x 1½" x 0.31" angles

Area = 2.15 sq. in.

$d_e$ = 22.98 in.

$f_y$ = 50,000 psi

$f_s$ = 30,000 psi

$f_{sc}$ = — psi

$M = A_{TCA}\ f_s\ d_e = (2.15)(30,000)(22.98)$

M = 1,470,000 in lbs.

CHORD MEMBER #7 Consists of 2 - 3" x 2" x 0.37" angles

Area = 3.66 sq. in.

$\ell$ = 55.25 in.

$r_x$ = 0.57 in.

$r_z$ = 0.94 in.

$\frac{\ell}{r_x}$ = 61.9

$\frac{\ell}{2r_z}$ = 80.2

$f_y$ = 36,000 psi

$f_s$ = — psi

$f_{sc}$ = 16,340 psi

(With fillers where required)

$d_e$ = 22.98 in.

$M = A_{BCA}\ f_{sc}\ d_e = (3.66)(16,340)(22.98)$

M = 1,374,000 in lbs.

MAXIMUM NEGATIVE MOMENT = 1,374,000 in. lbs.

POSITIVE MOMENT

CHORD MEMBER #7 Consists of 2-3"x 2"x 0.37" angles

Area = 3.66 sq. in.

$D_t$ = 29.5 in. $f_y$ = 36,000 psi

$B_{eff}$ = 64.0 in. $f_s$ = 22,000 psi

t = 4.00 in. $f_{sc}$ = — psi

$y_1$ = 2.00 in.

$y_2$ = 5.96 in. $d_3$ = 22.25 in.

$y_3$ = 28.94 in. $c_1$ = 6.69 in.

$d_1$ = 4.69 in. $c_2$ = 22.81 in.

$d_2$ = 0.73 in.

$$I_s = (I_c + A_c d_1^2) + (I_{TCA} + A_{TCA} d_2^2) + I_{BCA} + A_{BCA} d_3)$$

$$\bar{y} = \frac{(A_c y_1 + A_{TCA} y_2 + A_{BCA} y_3)}{(A_c + A_{TCA} + A_{BCA})}$$

$\bar{y}$ = 6.69 in.

$I_s$ = 2,214 $in.^4$ ( C 28 T 9 )

Resisting Moment = $f_s \times \frac{I_s}{c_2}$ = 2,133,000 in. lbs.

Composite Design Top Chord Check

Applicable Moment = 2,133,000 in. lbs. $f_c$ = 3,000 psi

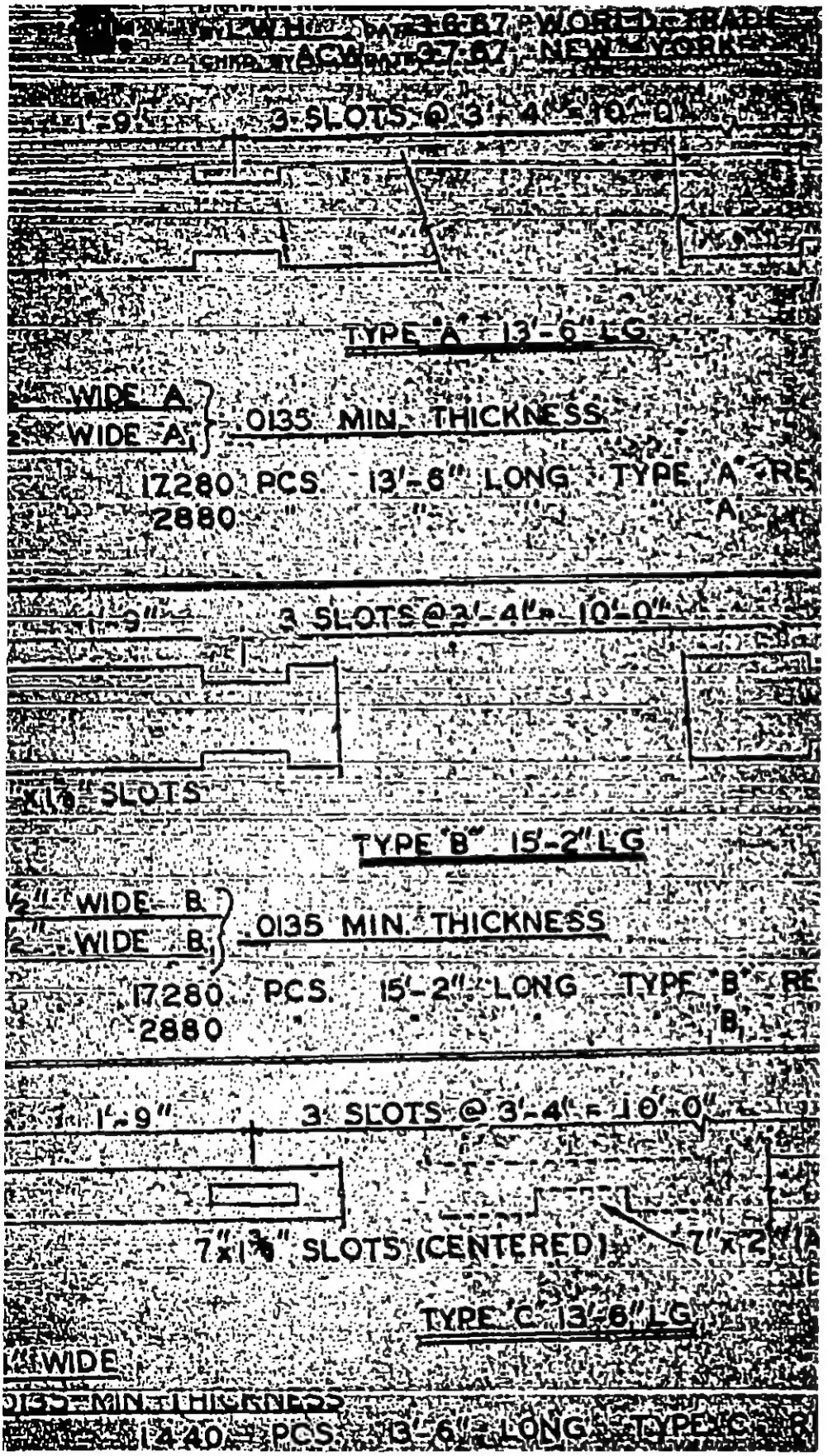
$f'_c$ = 1,350 psi

$f'_{cc} = \frac{Mc_1}{15 I_s}$ = 430 psi

Maximum Positive Moment = 2,133,000 in. lbs.

Design of Web $f_y$ = 36,000 psi

Use 0.92" DIA. Area = 0.67 sq. in.


ACW
3 SLOTS @ 3'-4" = 10'-0"
1'-9"
TYPE "A" 13'-6" LG
WIDE A
WIDE A
.0135 MIN. THICKNESS
17280 PCS 13'-6" LONG TYPE "A" RE
2880 " " " A
3 SLOTS @ 3'-4" = 10'-0"
1'-9"
SLOTS
TYPE "B" 15'-2" LG
WIDE B
WIDE B
.0135 MIN. THICKNESS
17280 PCS. 15'-2" LONG TYPE "B" RE
2880 " " " B
3 SLOTS @ 3'-4" = 10'-0"
1'-9"
7" x 1 3/8" SLOTS (CENTERED)
7" x 2"
TYPE "C" 13'-6" LG
WIDE
.0135 MIN. THICKNESS
1440 PCS 13'-6" LONG TYPE "C" R

DRAWING NO. ST-112 PROJECT [illegible]
BY L.W.H. DATE 3-6-67 WORLD TRADE [illegible]
CHKD. BY ACW DATE 3-7-67 NEW YORK [illegible]

7" x 1¾" SLOTS (CENTERED) 7" x 2" (ALTERNAT

TYPE D 15'-6" LG

4" WIDE .0135 MIN. THICKNESS

1440 PCS. 15'-6" LONG TYPE D RE

TYPE E 16'-10" LG

6½" WIDE .0135 MIN. THICKNESS

8640 PCS. 16'-10" LONG TYPE E RE

TYPE F 16'-10" LG

8½" WIDE .0135 MIN. THICKNESS

1440 PCS. 16'-10" LONG TYPE F R